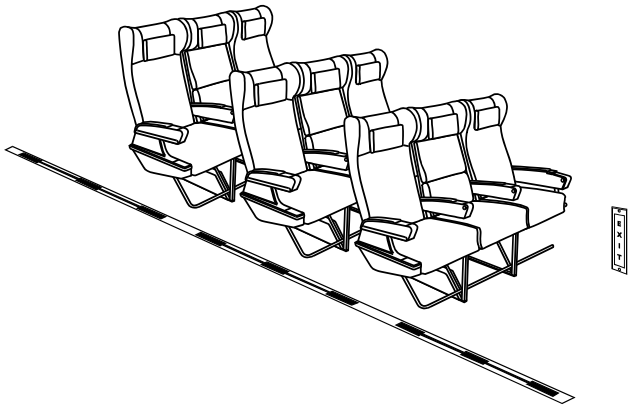
LSI Luminescent Systems Inc.

SYSTEM MAINTENANCE and INSTALLATION MANUAL

Floor Mounted Electroluminescent

Emergency Egress Lighting (EEL) System



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HIGHLIGHTS WITH RESPECT TO REVISION N° 6

This Revision 6 replaces Revision 5 dated 1 July 1995 in its entirety.

Revision 6 represents a substantial rewrite of the System Maintenance and Installation Manual for the LSI Emergency Egress Lighting (EEL) System providing floor mounted Floor Proximity Escape Path Marking in fixed wing aircraft in accordance with FAR/JAR and CAA regulations.

Revision 6 of the System Maintenance and Installation Manual employs the philosophy that the system is composed of a number of Line Replaceable Units, which are not line or shop repairable, plus Power Supplies, which are repairable.

The System Maintenance and Installation Manual covers all items of the system, excluding detailed data on the Power Supplies with and without Battery and the Battery itself for the latter. An introduction to these components is included to allow easy familiarization with the whole system even though each Power supply (both those with and those without) and the Battery are covered by their own, separate Component Maintenance Manual (CMM). Refer to Publication Index LSI #95373 for an overview and cross-reference list.

This document, 33-50-01 is to be used in conjunction with the following other documents:

33-50-02 IPC, EEL System, Floor Mounted Track System
33-50-03 IPC, Exit Markers
33-50-04 IPC, Power Supplies without Batteries
33-50-05 IPC, Power Supplies with Batteries
33-50-12 IPC, Connectors
33-50-13 IPC, Galley Lights

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DESCRIPTION & OPERATION

1. Introduction

As part of the Federal Aviation Administration's (FAA) continuing efforts to upgrade aircraft cabin safety and improve occupant survivability in aircraft accidents, the provisions of Part 25 of the Federal Aviation Regulation (FAR) requiring Floor Proximity Emergency Escape Path Marking (FPEEPM) were established.

The sections related to FPEEPM in the FAR are:

- Section 25.812 Emergency Lighting
- Section 121.310 Additional Emergency Lighting

The amendments 25-58 and 121-183 (49 FR 43182) were issued on 26 October 1984. See included "FAA Advisory Circular" in Appendix B.

Since the establishment of these rules, aviation agencies around the world have accepted these or similar regulations including the UK Civil Aviation Administration (CAA) in "CAA Airworthiness Notice n° 56" (see Appendix C), and the Joint Aviation Administration (JAA).

2. EEL Design Concept

The ultimate test of any emergency system is the ability to reliably perform in a catastrophic situation. Since an EL lamp is solid state, it is the ideal technology to use as the basis for such a system since it will survive a crash without breaking. In a smoke-filled environment, the area light of the EL lamp is far more visible than a point source of light and, in a continuous line of light configuration it provides passengers the best orientation possible to help find the exits.

LSI's Emergency Egress Lighting (EEL) system, as described in the following chapters, is designed with a number of very important goals in mind including:

- EL lamps - cold, solid state, very low current devices - as basic component
- Capability of receiving severe damage and still remaining operational
- No fragile parts such as glass bulbs with filaments that can break
- Power supplies with internal and external short-circuit protection
- Battery life exceeding operational and regulatory requirements
- Very easy and straight forward installation
- Light weight

In addition, the system has to offer the following advantages to airlines:

- Short installation time: ± 50-60 man hours on typical single aisle aircraft, ±80-200 man hours on typical multiple aisle, single level aircraft
- Modularity, to allow easy extension, shortening and re-configuration
- High durability
- High reliability with high Mean Time Between Failures (MTBF)
- Minimal maintenance requirements from D-check to D-check
- Interchangeability of components to meet Minimum Equipment List (MEL) requirements in case of"single-lamp-out" situations during pre-flight check
- Control for planned maintenance vs. unscheduled replacements
- Low cost of ownership
- Minimal delays

In order to meet requirements for ease of installation and maintain a level of high reliability for both airframe manufacturers and retrofitting airlines, LSI worked with airline avionics engineers to develop our Emergency Egress Lighting (EEL) System.

3. Electroluminescence

An electroluminescent (EL) lamp, the core of the EEL System, is a 'lossy' capacitor. Basically it consists of two conducting surfaces, of which one is translucent, with a dielectric in between. The luminescent pigment or phosphor is commonly dispersed within the capacitor dielectric. With AC current, the capacitor creates an electrostatic field over the dielectric and phosphor, causing the phosphor particles to become "luminescent", a term employed to describe the phenomena of light emission not due to the temperature of the source (such as incandescent filament type lamps). Since the phenomenon requires electricity, it is referred to as "electroluminescence".

As the process is a direct conversion of electricity to light, an EL lamp is a cold light source operating close to ambient temperature, with very low power consumption. Light is emitted from the entire area of the lamp strip rather than from a point source (as in the case of an incandescent bulb or LED). Because the lamp is an area light source, it is more visible in smoke than a point source since it is less susceptible to the scattering effects of the airborne particles.
In addition, EL Lamps are solid state. They withstand shock and vibration, thermal cycling and further thermal processing without breakage, providing extreme ruggedness and reliability.
Other major advantages include weight savings and freedom from catastrophic failure.

4. System Description

A basic EEL system consist of the following components:

- power supplies
- aisle lighting with EL lamps
- cable lead assemblies
- exit markers with EL lamps

Auxiliary EEL components include:

- galley lighting with EL lamps
- jumper cable assemblies

A. Power Supplies (Figure 1)

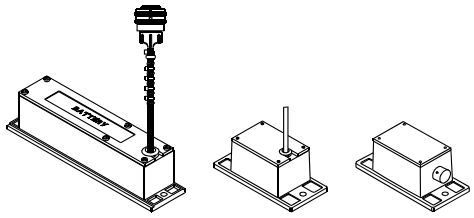

Figure 1: Various Power Supply Types

There are two basic power supply versions:

(1) The first one has a self-contained battery and an inverter module which controls logic switching and charging circuits. It is wired in parallel to the existing aircraft emergency lighting system and operates off the 28 VDC non-essential buss.

(2) The second version has an inverter module which is controlled by the existing aircraft logic switching system and requires aircraft emergency battery power which can be 6 VDC or 28 VDC, depending on the available battery power source.

Nominal output voltage for both power supplies is 115 VAC at 400 Hz at nominal load.
Both versions are housed in a LEXAN®[1] polycarbonate enclosure.

[1] LEXAN® is a registered trademark of General Electric Co. USA.

NOTE: EEL power supplies (with and without battery) and batteries are described in separate CMMs. Refer to Publication Index LSI #95373, for an overview.

B. Cable Lead Assemblies (see Figure 3)

Power from the EEL power supplies is fed through the aircraft wire harness (customer supplied) to the cable lead assembly into the LEXAN® track or galley lights of the lighting system. They are mainly flat ribbon cables provided in various lengths and come either with flying leads, to allow for customer installed connectors, or leads with a variety of connector options.

The cable lead assemblies must be protected by the thin, clear LEXAN® cable cover as they are exterior to the LEXAN® track or galley light.

C. Aisle Lighting

The main part of the floor lighting system is located in the aisle(s) of the aircraft cabin (Figure 2).

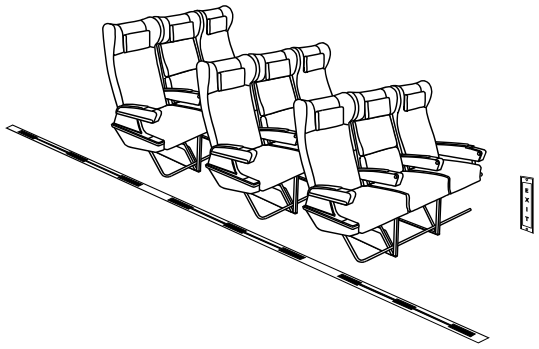

Figure 2:Location of EEL System in Aisle

It is housed in a durable LEXAN® track enclosure which consists of a clear or smoke tinted lens and a black base that snap together.

The ends of each track run are closed with snap-on type LEXAN® end caps.

The AC electrical power is distributed inside the LEXAN® track through flat ribbon cables (track cable assemblies) on which small connector pairs (cable connectors) are attached at fixed distances (cable pitch).

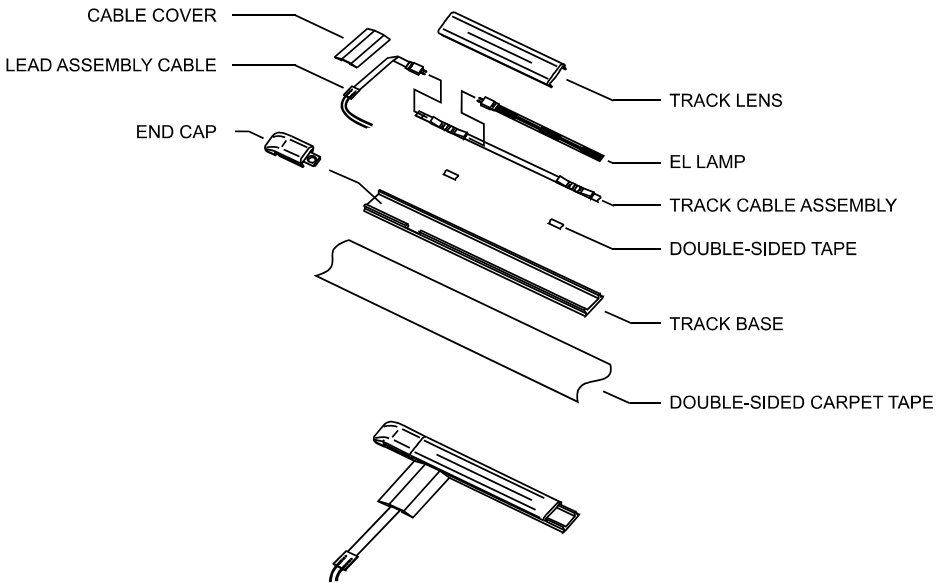

Figure 3: EEL System Basic Assembly

Light is emitted from flexible EL lamps which are plugged into the cable connectors.

D. Exit markers

All exits are identified by an EL exit marker, which are available in two different packages:

(1) The LEXAN® housed exit marker is the most widely used in normal commercial aircraft (Figure 4).

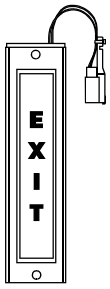

Figure 4: LEXAN® Exit marker

Characteristics and configurations are as follows:

- durable LEXAN® Polycarbonate enclosure with replaceable lens
- secured to aircraft bulkhead on two places
- different overlays, to suit regulation and language requirements:
  - single or bilingual lettering
  - solid or outlined lettering/arrows
  - combinations of lettering with various arrow orientations
  - red or black color
- flying wires
- various connector options, to suit aircraft requirements

(2) The fiber glass exit marker is most suitable when cabin space is limited (small aircraft), for use on VIP aircraft and when appearance is important (Figure 5).

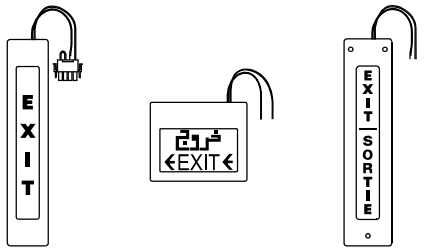

Figure 5: Fiber Glass Exit markers

It has the following characteristics:

- much thinner and more durable than the LEXAN® Exit marker
- available in a flat or curved configuration
- white border
- with and without mounting holes
- different overlays, to suit regulation and language requirements:
  - single or bilingual lettering
  - solid or outlined lettering/arrows
  - combinations of lettering with various arrow orientations
  - red or black color
- flying wires
- various connector options, to suit aircraft requirements

E. Galley Lighting (Optional)

The parts of the floor lighting system that require more durability and ruggedization as compared to the track system, such as in the galleys, near lavatories or wet entry doors of the aircraft cabin, use the same technology as the track system, but the cables and EL lamps are encapsulated in fiber glass. Galley lights are manufactured to withstand continuous foot traffic as well as abuse from trolley wheels, metal containers and other galley-related equipment.

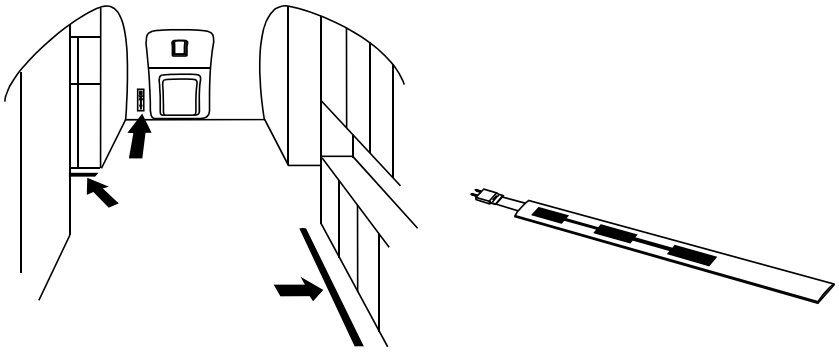

Figure 6: Galley Light Application and Location

F. Jumper Cable Assemblies
These flat ribbon cables are used to bring power into or take power off one section of the aisle lighting to other sections of the lighting system or galley lights located in the cabin of the aircraft.
The jumper cable assemblies must be protected by the thin, clear LEXAN® cable cover as they are exterior to the LEXAN® track or galley light.

5. EEL System Operation
The FPEEMPS lighting is connected in parallel to the normal overhead emergency lighting circuitry, aircraft cockpit 3 position switch ("ON"/"OFF"/"ARM" per FAR 25.812 (f)(3)), and the flight attendant 2 positions switch(es) ("NORMAL"/"ON" per FAR 25.812 (f)(1)).

A. System Non-operative ("OFF").
The lighting system is non-operative when the cockpit ON/OFF/ARM switch is purposely set to the "OFF" or disarm position.
When in the "OFF" position and connected to ground power, the self-contained batteries (when fitted) of the EEL power supply will continuously trickle charge through the power supply's charge control circuitry.

B. System Armed for Activation ("ARM").
During normal flight conditions, the system should be purposely switched to the "ARM" condition. Only abnormal electrical damage to system or emergency conditions will cause the EEL system to activate, otherwise the system is dormant.
Emergency conditions may include fire and/or an aircraft crash with loss of aircraft electrical power.
When in the "ARM" position and connected to aircraft power (and the system is non-operative), the self-contained batteries (when fitted) of the EEL power supply will continuously trickle charge through the power supply's charge control circuitry.

C. System Operative ("ON").
The aisle lighting is operative when purposely switched to the "ON" position.
With aircraft power available to the power supply while the switch is set to "ON", the self-contained batteries (when fitted) of the EEL power supply will supply most of the power to the FPEEPMS.
With aircraft power not available, however, while the switch is set to "ON", the self-contained batteries (when fitted) of the EEL power supply will discharge through the power supply inverter to light up the FPEEPMS.
This setting is used for:
- maintenance inspections,
- pre-flight MEL verification,
- during the safety and evacuation procedures presentation by flight attendants,
- purposely activating the system when the aircraft crew observe an abnormal situation that is not automatically detected but necessitates manual system activation ("manual" per FAR 25.812 (f)(1)).

NOTE: For aircraft using FPEEPMS power supplies without battery, operation is similar. In this case, the power supplies are run off aircraft batteries.

6. EEL Layout Design - Preparation

A. General.

The layout of an EEL system for any aircraft type, whether commercial airliner or VIP, is dependent of the aircraft configuration.

Based on the size of the aircraft, its cabin features, available power supply locations and available aircraft power, the components (for a complete overview, see IPL) can be configured to provide an optimal system.

The following sections describe how the layout design for an EEL system can be accomplished in accordance with the current regulations. They also include recommendations with respect to choice of components.

B. Regulations.

Current regulations require electroluminescent FPEEPMS installations to be designed keeping a number of factors in mind. Therefore, specific requirements of the airworthiness authorities are explained when required.

The actual FAA and CAA guidelines for FPEEPMS design are included in Appendix B, FAA Advisory Circular 25.812-1A and Appendix C, CAA Airworthiness Notice 56.

C. Aircraft Floor Plan.

In order to know the aircraft's cabin layout, a detailed floor plan with all pertinent information is essential (Figure 7). This information should include at least:

(1) aircraft manufacturer and type
(2) exit locations
(3) galley locations
(4) power source location
(5) power source: battery or non-essential buss
(6) power system: 6 or 28 VDC
(7) cabin class(es) and number of rows per class
(8) seat pitch
(9) carpet type (stitched or non-stitched)
(10) carpet thickness
(11) station locations of all the above properly marked

D. EEL Components Overview.

Figures 7, 8, 9 show the typical components for a single aisle aircraft, single aisle aircraft with a galley area and a multiple aisle aircraft.

BILL OF MATERIALS for TYPICAL SINGLE AISLE AIRCRAFT

ZONE #1		ZONE #2		ZONE #3		ZONE #4		ZONE #5		FLOOR TRACK COMPONENTS	
P/N	QTY	P/N	QTY	P/N	QTY	P/N	QTY	P/N	QTY	P/N	QTY
5822-33	1	5822-33	1	5822-33	1	5822-33	1	5822-33	1	5872-1	3
5820-11	2	5820-11	2	5820-11	2	5820-11	2	5820-11	2	5873-1	3
5879-1	1	5879-1	1	5879-1	1	5879-1	1	5879-1	1	6144-1	4
6464-1	1	6464-5	1	6464-4	1	6464-5	1	6464-3	1	6012-1	5
36262-4	2	36262-4	6	36262-4	5	36262-4	6	36262-4	4	5835-1	1
60136	1	60136	1	60136	1	60136	1	60136	1		
60120	8	60120	8	60120	8	60120	8	60120	8		
60121	3	60121	2	60121	2	60121	2	60121	2		
60122	12	60122	8	60122	8	60122	8	60122	8		
6025-2	1										

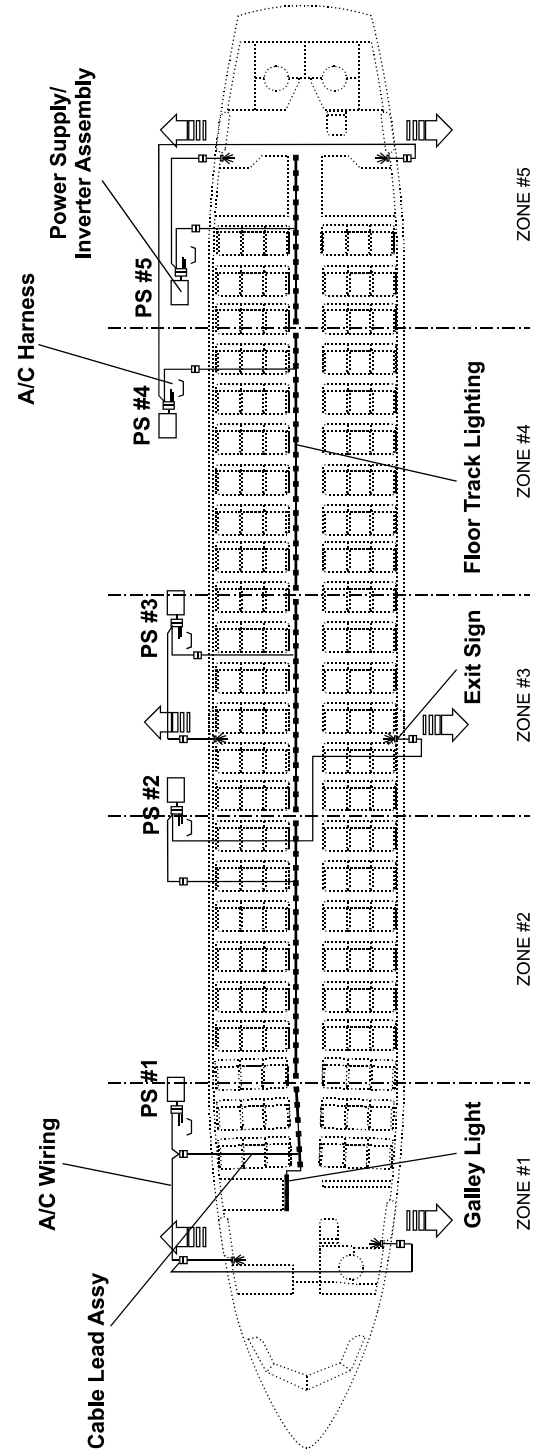

Figure 7: Aircraft Floor Plan with EEL System Layout

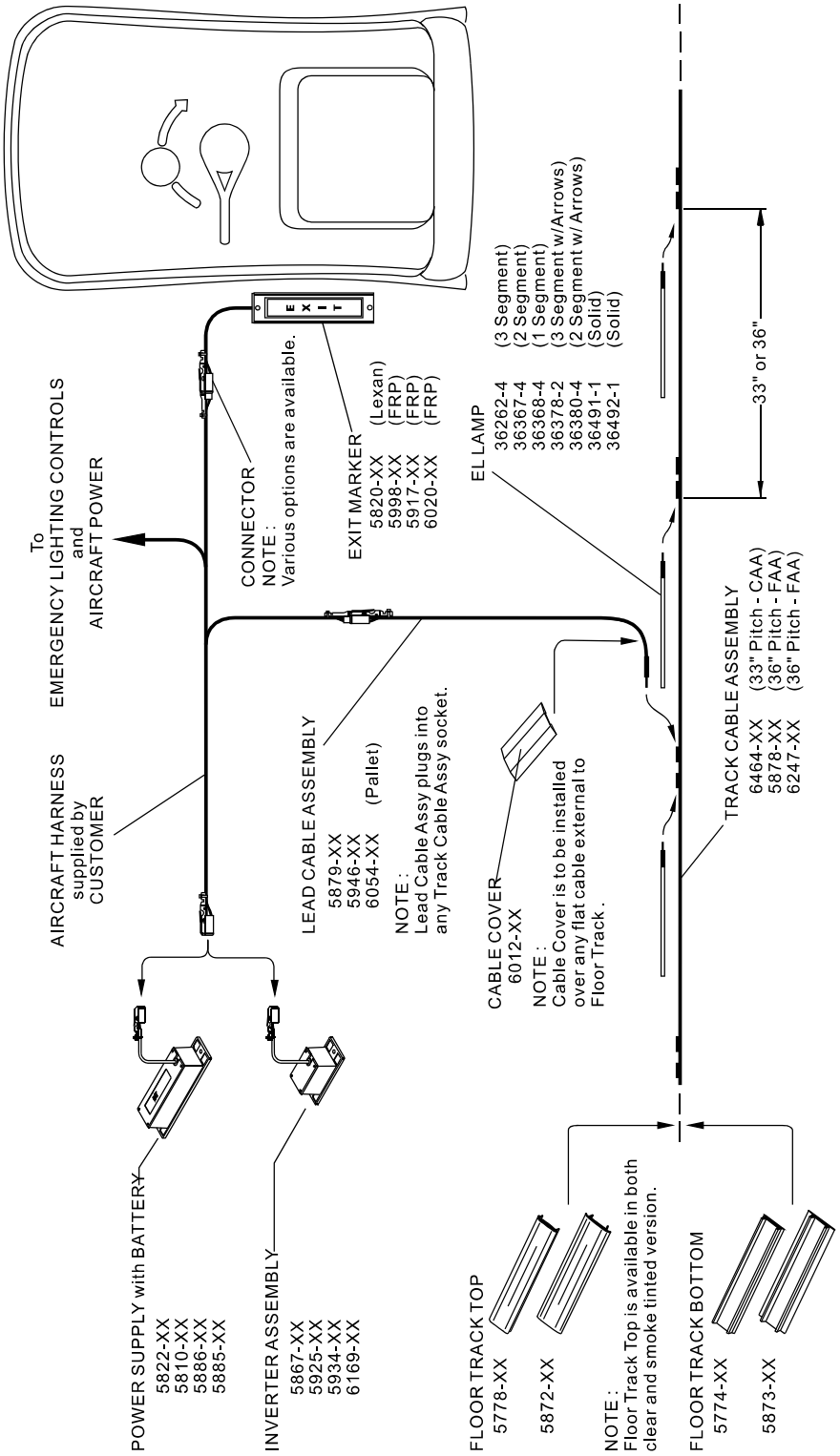

Figure 8: Components Overview for Typical Single Aisle Aircraft

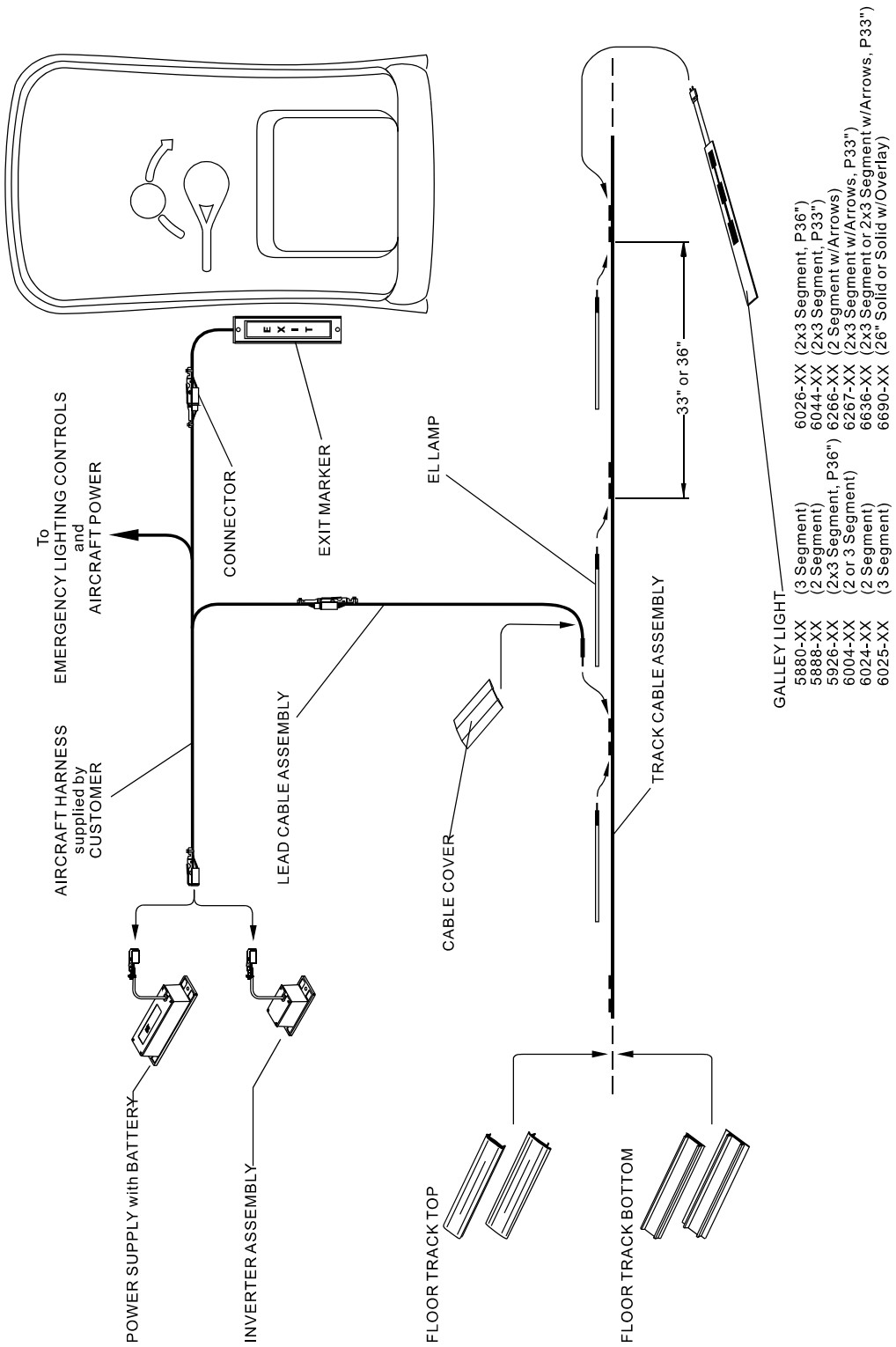

Figure 9: Components Overview for Typical Single Aisle Aircraft with Galley Lights

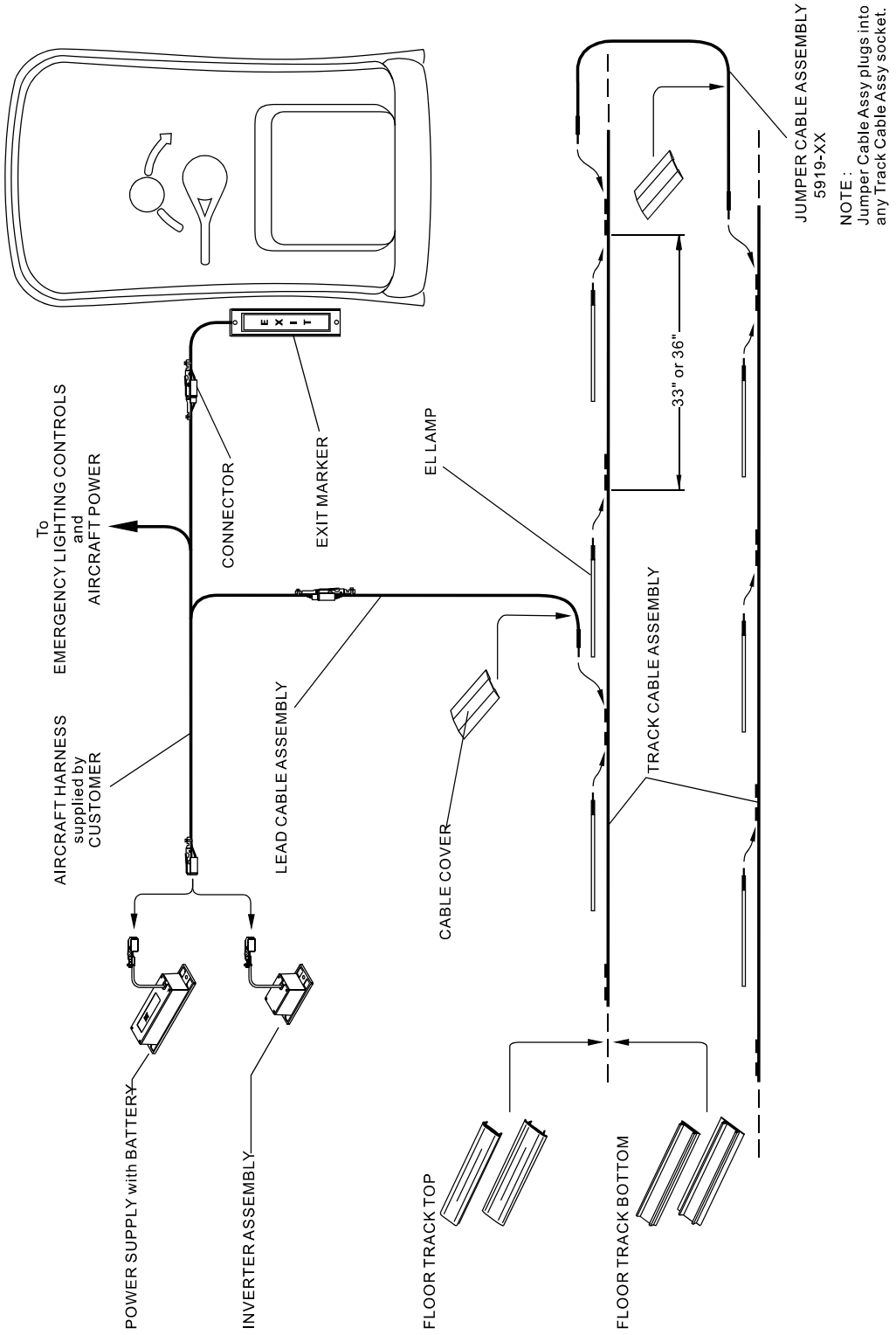

Figure 10: Components Overview for Typical Multiple Aisle Aircraft

7. EEL Layout Design

Starting from the aircraft floor plan (Figure 7), the EEL system layout design sequence described in the following sections can be followed.

A. Determine Exit Locations

(1) Regulations: FAR/JAR 25.812(e)(2), CAA AWN 56 §2.6.

(2) Each emergency exit should be marked with an exit marker located below 4 ft (1.2 m). To meet CAA regulations, the exit marker should be mounted at least 1.5 ft (0.45 m) above the floor.

(3) The EEL system provides two exit marker types (see IPC 33-50-03):

(a) LEXAN® housed: one size available with different overlays and various connector options.

(b) fiber glass encapsulated: several sizes available with different overlays and various connector options to suit special customer requirements.

(4) Choose the exit marker overlay as a function of the location where an exit marker is either required or assists in locating the exit.

(5) Mark position of each exit marker with part number.

B. Layout Aisle and Galley Lighting

(1) Regulations: FAR/JAR 25.812(e)(1) and (2), CAA AWN 56 §2.2 and §2.7.2.

(2) Placement of the track can be slightly under the seat but must be fully visible up to 4 feet above the floor (see Figure 11).

(3) Determine where the FPEEPMS will be located and mark the floor plan.

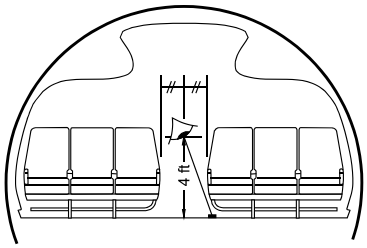

Figure 11: Aisle Lighting Location along Aisle under Seat

(4) Determine Track Cable Type

The EL lamps are plugged into a cable track assembly, which has connectors set at pre-determined distances which thus determine the distance between the EL lamps and their segments.

This cable track assembly of the EEL system is available in two configurations:

- the FAA accepted EL lamp spacing or pitch is 36 inches (0.91 m). This pitch provides a distance between the first and last segments of two consecutive EL lamps of 10 inches (0.25 m), which is equal to the distance between the segments on the EL lamps themselves.
- the maximum marker spacing allowed by the CAA regulations is 20" (0.5 m). In addition, the CAA requires that "the maximum distance between two markers should not be more than 40 inches under typical MEL conditions" (= failure of one marker). The corresponding EL lamp spacing (for a 26" EL lamp) is 33 inches (0.84 m). This pitch provides a distance between the first and last EL Lamp segments of two consecutive EL lamps of 7 inches (0.18 m). This pitch is also acceptable to the FAA as the lamps are spaced closer than 36", which is the FAA acceptance spacing.

Continuity with one or the other of these regulations should be respected throughout the cabin layout.

C. Choose Cable Track Assembly

The length of the cable track assembly is determined by the number of EL lamps/galley lights in each section/subsection: the number of connector pairs on the cable track assembly determines its length and the number of EL lamps than can be plugged into it.

(1) Add the quantity and part number(s) of the cable track assemblies.

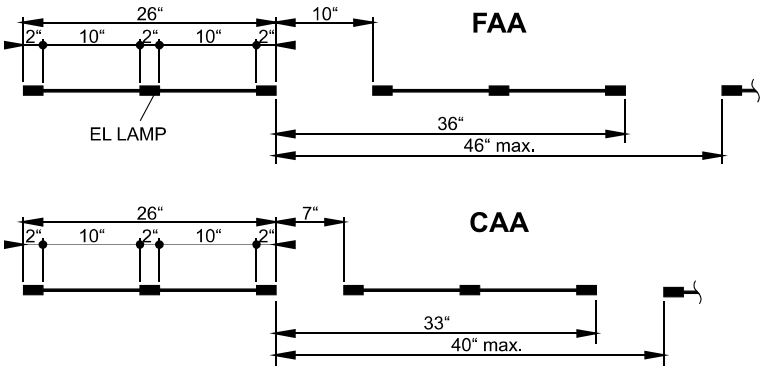

Figure 12: FAA and CAA Lamp Spacing

(2) Use of Floor Track or Galley Lights

The use of either floor track or galley lights should be considered at the same time when the system is laid out.

The floor track should be used wherever there is a textile floor/carpet.

Galley lights are much thinner and have better mechanical resistance to damage and moisture than the floor track. They should be used:

- wherever there is heavy traffic or moisture present (lavatories, galleys, entry ways or doors).
- in the galley section(s) of the cabin.

NOTE: Avoid designing aisle lighting where trolleys may ride over the system. When unavoidable always specify encapsulated galley lights for these locations.

NOTE: Avoid electrical connections/connectors immediately underneath track butt-joints.

(3) Draw EL lamps on the floorplan every 33 inches (0.84) or 36 inches (0.91 m) in carpet sections, depending on applicable regulation. EL lamps are available in 3 sizes:

- 1 segment, 3 inches
- 2 segment, 14 inches
- 3 segment, 26 inches

(4) Aisle Cues for Overwing Exits and End of Cabin

Per FAA and CAA an orange or red overlay is to be added on top of the EL lamp at non-floor level overwing exits. The CAA requires the same overlay at the ends of the cabin. A minimum of two and preferably three EL lamp segments should be covered with the overlay.

(5) Mark the EL lamps on the floor plan that will have orange/red overlay.

(6) Aisle Cues for Dead Ends: FAA AC to FAR 25.812 Appendix 1, §5.a. and CAA AWN 56 §2.4 require the EEL system to have red overlay arrows to indicate that there are no exits to be found in the direction opposite to the arrows (typically in dead ends).

(7) Mark the EL lamps on the floor plan that have Red Arrows with the EL lamp part number.

(8) Draw galley lights on the floor plan in galley and non-textile floor areas.

D. Choose Power Supply Type:
(1) Regardless of power supply part number, choose a low power unit (drives 6 to 28 in^2, 20 in^2 typical, EL lamp load) or a high power unit (drives 12 to 40 in^2, 35 in^2 typical, EL lamp load).

E. Analyze Power Supply Load:
(1) In order to meet the "Breakup rule" or "25 % rule" described in FAR 25.812(l)(1) and CAA AWN 56 §2.11 a minimum of 4 independently powered circuits/sections are required so that no more than 25% of the complete installation is inoperable when one section fails.
(2) Calculate the total load of EL lamps, galley lights and exit markers (in square inches of lit area). Use the load data in Table 1 below.
Combine listed lamp lit areas in Table 1 for multiple EL lamp galley lights.
(3) Power Supply quantity:
Divide the load in in^2 of the entire A/C EEL system by the typical load for the power supply. The permissible lamp load characteristics of each of the power supplies should be respected. Refer to the power supply CMM for detailed characteristics. The EL lamp load should be divided as equally as possible among the power supplies.
(4) Note each section with its power supply part number separately on the "Power Supply Load Plan".
(5) Keeping the permissible load characteristics of the power supplies in mind, divide the aisle lighting (EL lamps and galley lights only) in at least 4 separate sections so as to comply with the "25% rule".
(6) Assign each exit marker to a section so as to comply with the "25% Rule".

Exit marker	**Lit Area**
5820-XX Series	6.0 in^2
5917-XX Series	6.0 in^2
5998-XX Series	4.5 in^2
6020-XX Series	6.0 in^2
7465-XX Series	6.0 in^2
7668-XX Series	6.0 in^2
EL Lamp/Galley Light	**Lit Area**
1 Segment, 3"	0.5 in^2
2 Segment, 14"	2.6 in^2
3 Segment, 26"	3.5 in^2
Solid, 14"	3.7 in^2
Solid, 26"	6.8 in^2
NOTE: For multiple lamp galley lights, add-up lit area of respective lamps.	

Table 1:Typical EL Lamp Data to Calculate Power Supply Load

(7) Power Supply Load Plan:
Per section, list the quantity and part number of each EL lamp/galley light/exit marker.
(8) Calculate the load per section and compare with the permissible load

characteristics of the power supply.
The quantity of EL lamps/galley lights/exit markers per section is to be such that the maximum load of the power supply is not exceeded. Refer to the power supply CMM for detailed characteristics.

(9) Modify and repeat items (d) through (h) until the load per power supply are equally balanced and are within the design range of the power supply.
Modify the load of each section by moving EL lamps from one section to another. Avoid moving exit markers from one section to another once assigned to a section (25% rule).

(10) The quantity of power supplies required is equal to the number of sections with a minimum of 4 on a single aisle aircraft.
An optional solution is to use 5 power supplies to offer more design flexibility in complying to the "25% rule".

(11) Mark the part numbers, the quantity per part number of each EL lamp/exit marker/galley light/overlays in the section where it is installed.

F. Interconnecting Aisle Lighting Sections

To avoid being required to bring power from the aircraft wiring to each separate subsection of a particular section of aisle lighting, the EEL system has several jumper cable assemblies which allow interconnection of subsections underneath the carpet.

(1) Draw the jumper cable assembly between the aisle lighting subsections that it interconnects on the floorplan. Use straight angles when routing the jumper cable Assemblies. The male connectors on each side of the jumper cable assembly can be connected to any female cable track assembly connector within the floor track. Do not make cable folds in traffic areas. Make folds near walls or under seats to provide maximum protection.

(2) Specify the specially designed cable cover as protection for jumper cable assembly.

(3) Add the quantity and part number of jumper cables and cable cover to the bill of materials.

G. Connection to Aircraft Wiring

The EEL system has several cable lead assembly options to interface with the aircraft wiring. The cable lead assembly brings power from either behind the aircraft interior trim or from below the floor in the cargo compartment, to each of the EEL sections within the cabin.

(1) Draw the cable lead assembly between the point where it enters the cabin and the aisle lighting. Use straight angles when routing the jumper cable assemblies. The male connector of the cable lead assembly can be connected to any female cable track connector within the floor track.

(2) Add specially designed cable cover as protection for cable lead assembly.

(3) Add the quantity and part number of cable lead assemblies and cable cover to the bill of materials.

(4) Choose Floor Track and End Cap Type
LSI offer two track types: flanged (with carpet grippers) and non-flanged. The flanged track is designed to grip non-stitched carpet. The non-flanged track is designed to be used in conjunction with stitched carpet and offers the advantage that the track does not require opening during carpet changing.

(5) Measure the length of the aisle lighting system (not including galley lights).

(6) The number of track components is determined by dividing the length of the aisle lighting system by the length of an individual track part (refer to IPC 33-50-02 for dimensions).

(7) End caps are to be used to end each section of track. LSI offers one flanged end cap which is compatible with the flanged track and two non-flanged end caps for use with the non-flanged track.

NOTE: Both track components can be used together. However, it is recommended to use the flanged track base with the narrow track lens as it allows a wider surface area of adhesion to the floor panels compared to the non-flanged track base. The narrow track lens and end caps are compatible with the flanged track base.

(8) Add the quantity and part number of the floor track and end caps to the bill of materials.

H. Choose Power Supply Part Number

(1) Very often, the choice between a power supply with or without battery depends on whether the EEL system is installed on a new production aircraft or whether it is the subject of a retrofit. In the latter there may not be enough battery capacity available on the aircraft's emergency battery to add another system. In order to provide a solution to suit various aircraft types and installation situations, LSI offers several power supply choices. The most suitable one for an aircraft is dependent on the following:
   (a) aircraft emergency lighting logic
   (b) aircraft power system available: 6VDC or 28VDC
   (c) aircraft battery capacity
   (d) aircraft connector system used

(2) Battery Back Up
The EEL power supply, through its self-contained, battery provides between 60-90 minutes of battery backup depending on the EL lamp load.
When power supplies without battery are used, the aircraft battery should be capable to provide the required 10 minutes autonomy per FAR 25.812(i).

(3) Power Supply Load
Once a particular power supply part number has been chosen, re-verify the load of each power supply in the EEL layout. Use the values in Table 1 to calculate the loads.

(4) Compare the total load with the actual permissible load in the CMM of the power supply or the permissible load in Table 2 and 3.

(5) Modify the power supply loads when required.

(6) Mark power supply part number and quantity.

(7) The choice of a suitable physical location for the power supply is influenced by the ease of access for maintenance and connection to the aircraft wire harness.

5822-XX	Power Supply, with Batteries		
	EL Lamp Load	min.	12 in²
		typ.	30 in² (design load)
		max.	40 in²
	Input Voltage	typ.	28 VDC
	Charging Current	nom.	45 mA @ 28 VDC
	Aircraft Types		B707, B727, B737, B747, B757, B767, DC-8, DC-9/MD-80, DC-10, L1011, F-27/28, A300, A310, A320, Mercure, Caravelle, BAC-1-11, Concorde, Convair, HS748
5885-XX	Power Supply, with Batteries		
	EL Lamp Load	min.	6 in²
		typ.	18 in² (design load)
		max.	28 in²
	Input Voltage	typ.	28 VDC
	Charging Current	nom.	45 mA @ VDC
	Aircraft Types		B727, B737, C-212, DH7/8, YS-11
5810-XX	Power Supply with Integrated Exit marker (similar to 5822-XX)		
	EL Lamp Load	min.	12 in²
		typ.	30 in² (design load)
		max.	40 in²
	Input Voltage	typ.	28 VDC
	Charging Current	nom.	45 mA @ 28 VDC
	Aircraft Types		DC-8, B707, B727, B737, Convair, Challenger
5886-XX	Power Supply with Integrated Exit marker (similar to 5885-XX)		
	EL Lamp Load	min.	6 in²
		typ.	18 in² (design load)
		max.	28 in²
	Input Voltage	typ.	28 VDC
	Charging Current	nom.	45 mA @ VDC
	Aircraft Types		B707, B727
7815-XX	Power Supply, with Batteries		
	EL Lamp Load	min.	12 in²
		typ.	30 in² (design load)
		max.	40 in²
	Input Voltage	typ.	28 VDC
	Charging Current	nom.	45 mA @ 28 VDC
	Aircraft Types		MD-90

Table 2:Characteristics of EEL System Power Supplies (with batteries)

5867-XX	Power Supply, without Battery		
	EL Lamp Load	min.	6 in²
		typ.	18 in² (design load)
		max.	28 in²
	Input Voltage	nom.	6 VDC
	Current Draw	nom.	300 mA @ 6 VDC
	Aircraft Types		B737-300/400, B757, B767-200/300, B747-400 (Upper Deck), BAe ATP, F-50, Canadair RJ
5925-XX	Power Supply, without Battery		
	EL Lamp Load	min.	12 in²
		typ.	30 in² (design load)
		max.	40 in²
	Input Voltage	nom.	6 VDC
	Current Draw	nom.	800 mA @ 6 VDC
	Aircraft Types		F-100, A320, B747-400, RJ, 737-300
5934-XX	Power Supply, without Battery		
	EL Lamp Load	min.	6 in²
		typ.	18 in² (design load)
		max.	28 in²
	Input Voltage	nom.	28 VDC
	Current Draw	nom.	100 mA @ 28 VDC
	Aircraft Types		SD3-60, SD3-30
6169-XX	Power Supply, without Battery		
	EL Lamp Load	min.	12 in²
		typ.	30 in² (design load)
		max.	40 in²
	Input Voltage	nom.	28 VDC
	Current Draw	nom.	150 mA @ 28 VDC
	Aircraft Types		MD-11

Table 3:Characteristics of EEL System Power Supplies without battery

8. EEL Layout Design: Summary

For a complete overview of all components, refer to the respective IPC's mentioned at the beginning of this document. For a complete overview of the regulations, refer to Appendix B for FAA and Appendix C for CAA regulations.

A. Obtain a detailed aircraft floor plan with the cabin layout.

B. Determine exit locations and mark with exit marker.

C. Determine FPEEPMS location and lengths of areas to be lit.

D. Determine regulation to be followed (FAA/CAA): choose cable track assembly type as function of regulations: 36 inches (0.91 m) pitch to meet FAA, 33 inches (0.84 m) pitch to meet CAA.

E. Normal cabin: space EL lamps at FAA or CAA pitch (see IPC for EL lamp types).

F. Galley/Lavatory areas: use encapsulated galley lights available in 1 or 2 lamp configurations which are pre-configured for FAA or CAA pitch (refer to IPC 33-50-13).

G. Aisle cues for overwing exits and end of cabin: add orange/red overlay on top of EL lamp.

H. Aisle cues for dead ends: use EL lamps with red arrows (refer to IPC 33-50-02).

I. Calculate total EL lamp lit area of EL lamps/galley lights/exit markers (in square inches - in^2): reference to Table 1 for EL lamp lit areas.

J. Choose the power supply's typical capacity (20 in^2 or 35 in^2).

K. Analyze power supply load.

L. Divide total EL lamp lit area by the typical capacity. Round to higher integer number. The resulting number represents the minimum quantity of power supplies. To meet the the "25% break-up rule" this number should be at least 4.

M. Adjust layout:
- Determine sections by assigning EL lamps/galley lights to each section.
- Evenly distribute all exit markers over sections so as to comply with the "25% Rule".
- Add sections when required by the cabin layout.

N. Re-verify the load that each section represents and compare with typical capacity of the power supply. Modify until each section has a load that is lower or equal to the typical capacity of the power supply.

O. Determine cable track assembly lengths.

P. Determine cable track assembly length as a function of the number of EL lamps or connectors required in each section/subsection.

Q. Interconnect aisle lighting sections with jumper cables. When path is not straight, use 90° angles when routing the jumper cable assemblies.

NOTE: Do not make cable folds in traffic areas. Make folds near walls or under seats. Add specially designed cable cover as protection for jumper cable assembly. Put a piece of double-sided tape at each fold to secure the flat cable in position.

R. Connect cable track assemblies to aircraft wiring with cable lead assemblies. Draw the cable lead assembly between the point where it enters the cabin and the aisle lighting (use 90° angles when routing the cable lead assemblies)

NOTE: Add specially designed cable cover as protection for cable lead assembly.

S. Choose floor track and end cap type: flanged (with carpet grippers) and non-flanged.

T. Measure the length of the aisle lighting system (excluding galley lights).

U. Divide the total length of the aisle lighting system by the length of an individual track part (refer to IPC 33-50-02). The resulting number is the quantity of track components needed.

V. Choose snap-on flanged or non-flanged end caps to terminate the track.

W. Choose power supply part number in accordance with aircraft logic.

X. Choose location in aircraft for the power supplies.

TESTING AND FAULT ISOLATION

1. General

The EEL system is modular in design to facilitate system installation and troubleshooting. Problems with the EEL system will be evidenced either by failure of one or more of the EL lamps or exit markers to illuminate, or failure of some or all of the EL lamps or exit markers to turn off when the system is disarmed/switched to "OFF".

System faults readily appear during a system check where all EL lamps and exit markers are supposed to be illuminated fully after the system has been switched to "ON" and non-illuminated after the system has been switched to "OFF".
If this is not the case, proceed as instructed below under paragraph 2. System Testing and Fault Isolation, and take action according to the observation of the system.

For testing and fault isolation of the power supplies, refer to the respective Component Maintenance Manual for that power supply part number (refer to IPC 33-50-04 for Power Supplies without Battery or IPC 33-50-05, Power Supplies with Battery).

2. System Testing and Fault Isolation

A. Definitions.

The following definitions are used for parts of the EEL system in this paragraph:

(1) EL lamps:
Refers to exit markers, galley lights and EL lamps of the aisle lighting.

(2) Section:
Refers to that part of the system which is powered by a single power supply.

(3) Power supply unit (PSU):
Refers to the power supply unit (can be power supply with or without battery).

(4) Unit Under Test (UUT):
Refers to the power supply unit (can be power supply with or without battery) that is being investigated.

B. Preparing the EEL System for Trouble Shooting.

Cycle the EEL system through an ARM-DISARM ("ARM"/"OFF") test cycle before starting any system level troubleshooting. When initially powered up, the logic units in the power supplies may come up in a logic state other than DISARM. Cycling the system precludes starting off from an unknown state.

C. Troubleshooting the EEL System

The troubleshooting charts provide a systematic way to locate and subsequently solve faults/errors that could occur. They can be used for Line Maintenance Repair.

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
A. EL Lamps will not light		
(1) All FPEEPM sections fail (complete system failure)	(a) Aircraft wiring failure	Check aircraft wiring.
	(b) PSU failure	Proceed to C.
(2) One or more FPEEPM sections fail completely	(a) PSU failure	Proceed to C. If not defective, proceed to (2)(b).
	(b) Broken aircraft wiring from PSU to FPEEPM section	Check for 115 VAC/400 Hz at A/C harness connector to cable lead assembly. If defective, repair/replace; If not, proceed to 2 (c).
	(c) Cable lead assembly failure	Check for 115 VAC/400 Hz at cable connector of cable lead assembly. If defective, replace cable lead assembly; If not, proceed to (2)(d).
	(d) Cable track assembly failure	Check cable track connectors for 115 VAC/400 Hz. If defective, replace cable track assembly; If not, proceed to (2)(e).
	(e) EL lamp(s) failure	Replace EL lamp(s).
(3) One or more EL lamps do not light in a FPEEPM section	(a) EL lamp not fully plugged into cable track assembly	Check EL lamp connector mating. If not mating, plug lamp fully; If mating, proceed to (3)(b).
	(b) Cable track assembly failure	Check connectors of non-illuminated lamps for 115 VAC/400 Hz. If defective, replace cable track assembly; If not, proceed to (3)(c) or (4).
	(c) EL lamp(s) failure	Replace EL lamp(s).
(4) Lamp(s) lit but not bright enough	(a) Insulation failure in aircraft wiring from PSU to FPEEPM section	Check wiring. If defective, locate insulation failure and repair/replace defective component(s); If not, proceed to (4)(b)
	(b) Lamp failure	Replace EL lamp(s).

Table 101: EEL System Troubleshooting

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
B. EL lamps will not go out		
(1) All FPEEPM sections stay on or comes on after DISARM command has been sent	(a) Aircraft wiring failure	Check for PSU receiving correct DISARM signal. Repair/replace aircraft wiring.
(2) One or more FPEEPM sections stay on or come on after DISARM command has been sent	(a) Aircraft wiring failure	Check for PSU receiving correct DISARM signal. If yes, proceed to (b). If not, repair/replace aircraft wiring.
	(b) PSU failure	Proceed to C.
C. PSU failure		
(1) PSU non-operative	(a) Broken wiring	Return PSU to shop for testing. If defective, replace PSU. Investigate reason.
	(b) Battery discharged	Return PSU to shop for testing. If defective, replace battery. Investigate reason.
	(c) Broken logic: electronic circuit failure (output voltage out of tolerance)	Return PSU to shop for testing. If defective, replace PSU. Investigate reason.
(2) PSU not working in accordance with logic provisions	(a) PSU defective.	Return PSU to shop for testing. If defective, replace PSU. Return defective PSU to LSI for analysis.

Table 102: EEL System Troubleshooting (Continued)

3. Trouble Shooting the Power Supply without Battery

The information given in this section is for information only. Refer to the CMM of the unit under test (UUT) for the actual procedure.

A. Introduction.

This PSU is a DC/AC converter. Its electronics are sealed and potted and cannot be repaired when defective.

B. PSU Operation.

This PSU is controlled by applying or removing DC power on its inputs. This power originates from the aircraft emergency battery, and can be either 6VDC or 28VDC depending on the aircraft battery used.

C. Troubleshooting the PSU

The information given in this section is for information only. Refer to the CMM of the UUT for the actual procedure.

In essence, the test is an ON/OFF test.

Application of appropriate power with the typical EL lamp load attached to the outputs of the UUT should make the EL lamp(s) light up.

NOTE: For reproducibility, it is recommended to simulate the typical load of the PSU with an equivalent load rather than using actual EL Lamps. An equivalent load consists of a capacitance (C_p), resistance (R_p) and typically also an indicator light all wired in parallel. The combined impedance represents the typical load for which the unit is designed. The indicator light will light up when AC voltage and frequency appears across the outputs of the PSU. Refer to the CMM of the UUT for values.

NOTE: Proper functioning of the PSU should also be verified with a voltage and frequency meter in parallel to the equivalent load.

4. Trouble Shooting the Power Supply with Battery

The information given in this section is for information only. Refer to the CMM of the PSU for the actual procedure.

A. Introduction.

The power supply with battery consists of a logic circuit, a DC/AC inverter and a battery. The electronics (logic and DC/AC inverter) in the power supply are sealed and potted and cannot be repaired when defective. The logic circuit design is matched with each specific aircraft signal and control system (see Figure 101).

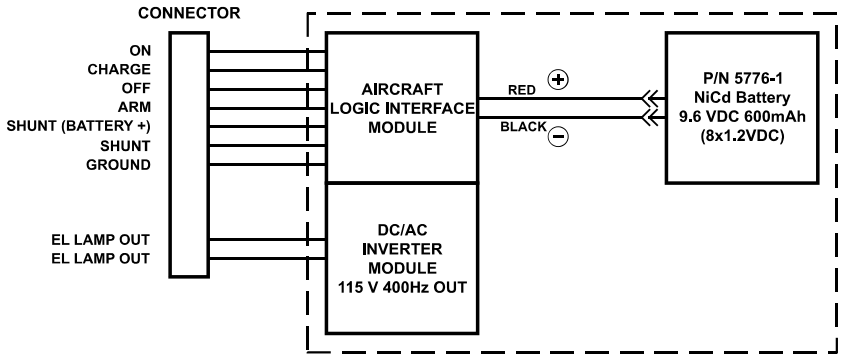

Figure 101: Power Supply Building Blocks

B. Troubleshooting the PSU.

CAUTION: BEFORE TESTING A POWER SUPPLY CONTAINING A BATTERY PACK, VERIFY THAT THE BATTERY IS FULLY CHARGED AND THE BATTERY IS CONNECTED TO THE POWER SUPPLY (WHEN A BATTERY IS USED IN THE TEST).

CAUTION: OPERATION WITHOUT THE BATTERY CONNECTED (WHEN REQUIRED) MAY DAMAGE THE INTERNAL LOGIC CIRCUIT OF THE POWER SUPPLY.

Application of the appropriate control signals in correspondence with the logic table mentioned in the CMM of the power supply, and the typical EL lamp load attached to the power supply's outputs, should make the EL lamp(s) light up.

NOTE: For reproducibility, it is recommended to simulate the typical load of the PSU with an equivalent load rather than using actual EL Lamps. An equivalent load consists of a capacitance (C_p), resistance (R_p) and typically also an indicator light all wired in parallel. The combined impedance represents the typical load for which the unit is designed. The indicator light will light up when AC voltage and frequency appears across the outputs of the PSU. Refer to the CMM of the UUT for values.

NOTE: Proper functioning of the PSU should also be verified with a voltage and frequency meter in parallel to the equivalent load.

Test each unit to verify that the EL Lamps of the FPEEPM system go into the appropriate ON or OFF state depending on the signals provided to the unit.

5. Power Supply Evolutions

The initial inverter module designs for the Power Supplies met all electrical requirements, and functioned as desired. On some aircraft however, the FPEEPMS experienced inadvertent triggering of the system. In response to this problem, a next generation of Power Supply electronics had to be developed for several parts.
The re-design also included"no load protection", so that the converter inside the Power Supply does not get damaged when there are no EL Lamps present on its outputs, cross polarity protection at the battery terminals, increase in the wire gauge to 22 AWG on the connector pigtail, and the usage of pre-tested electronic components.

As the aircraft are ageing, intermittent high voltage electrical spikes may become prevalent during their operation. These high voltage spikes eventually weaken and destroy the protective device inside the Power Supply. Some Power Supplies now have electronic opto-couplers vs. diodes to protect the unit against undesirable electrical activity on the aircraft busses.

All of the new designs are interchangeable with the older generation power supplies in Form, Fit, and Function. They are all controlled from the cockpit and/or cabin emergency lighting switches, and electronically by the aircraft emergency lighting system and both input and output characteristics remain unchanged.

Refer to the CMM of the corresponding part. IPC 33-50-04 and IPC 33-50-05 provide a cross-reference list.

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AUTOMATIC TEST REQUIREMENTS

1. General

Not applicable.

Automatic test requirements do not apply to the LSI EEL system because of the simplicity of system operation and verification.

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DISASSEMBLY

1. General
Disassembly of the EEL system can be accomplished with normal tools.

2. Disassemble/Remove Track Housing

CAUTION: ALL PARTS THAT HAVE BEEN IN CONTACT WITH SEALANT OR SILICONE SEALANT SHOULD BE CLEANED OR REPLACED.

CAUTION: AFTER REMOVING THE TRACK LENS, ALL SEALANTS SHOULD BE RENEWED TO ASSURE WATERTIGHT SEALS AROUND CONNECTIONS, ANGLES, CORNERS.

CAUTION: TAKE CARE NOT TO DAMAGE THE CABLE TRACK ASSEMBLY AND EL LAMPS THAT ARE IMMEDIATELY UNDERNEATH THE TRACK LENS.

CAUTION: DO NOT DAMAGE THE EL LAMP AND CABLE CONNECTOR PINS DURING REMOVAL.

A. Remove Track Lens at End Cap.
   (1) Put a screwdriver in the gap between End Cap and Track Lens.
   (2) Lift the Track Lens.
   (3) Pull off the Track Lens from the Track Base.

B. Remove Track Lens at Butts/Connections.
   (1) Put a screwdriver in the gap between the Track Base and Track Lens.
   (2) Lift the Track Lens.
   (3) Pull off the Track Lens from the Track Base.

C. Remove End Cap.
   (1) Remove using a screwdriver. Pry upwards.

D. Remove EL Lamps.
   (1) Lift the EL Lamp gently at the end opposite the lamp connector until the tape on the back of the lamp has released.
   (2) Take hold of the EL Lamp behind the lamp connector and pull it carefully out of its cable connector in order not to damage the connector pins.

E. Remove Cable Lead Assembly.
   (1) Disconnect Cable Lead Assembly connector from aircraft wire harness.
   (2) Lift carpet and remove Cable Cover.
   (3) Take hold of the Cable Lead Assembly at its connector and pull it carefully out of the Cable Track Assembly connector in order not to damage the connector pins.
   (4) Take hold of the Cable Lead Assembly and pull it carefully away from the Double-Sided Carpet Tape.
   (5) Remove remaining Double-Sided Carpet Tape from the floor panels.

F. Remove Cable Track Assembly.
   (1) Take hold of the Cable Track Assembly at one of its ends and pull it away from the Double-Sided Tape inside the Track Base.

G. Remove Track Base.
   (1) Remove all tape and any fasteners inside the Track Base.

(2) Take hold of the Track Base at one end and pull it away from the floor.
(3) Remove remaining Double-Sided Carpet Tape from the floor panels and Track Base.

3. Disassemble/Remove Exit marker

CAUTION: TAKE CARE NOT TO DAMAGE THE FIBER GLASS LAMINATE OF THE EXIT marker.

A. Remove LEXAN® or Fiber Glass Exit marker attached with Fasteners.
(1) Remove fasteners.
(2) Take hold of Exit marker connector and disconnect from aircraft wire harness connector.

B. Remove Fiber Glass Exit marker attached with Tape and/or Fasteners.
(1) Remove Fasteners.
(2) Put a screwdriver in the gap between the Exit marker and aircraft bulkhead when it is attached with tape.
(3) Lift the Exit marker.
(4) Gently pull the Exit marker from the bulkhead.
(5) Take hold of Exit marker connector and disconnect from aircraft wire harness connector.

4. Disassemble/Remove Galley Light

CAUTION: TAKE CARE NOT TO DAMAGE THE FIBER GLASS LAMINATE OF THE GALLEY LIGHT.

A. Remove Fiber Glass Galley Light connected to Cable Track Assembly.
(1) Lift the Track Lens as described in 2.1 at the end where the Galley Light is connected.
(2) Disconnect the Galley Light connector from the Cable Track Assembly connector.
(3) Put a screwdriver in the gap between the Galley Light and aircraft floor panels.
(4) Lift the Galley Light.
(5) Gently pull the Galley Light away from the floor panels.

B. Remove Fiber Glass Galley Light connected to Aircraft Wire Harness.
(1) Disconnect the Galley Light connector from the aircraft wire harness connector or the Cable Lead Assembly connected to the aircraft wire harness.
(2) Put a screwdriver in the gap between the Galley Light and aircraft floor panels.
(3) Lift the Galley Light.
(4) Gently pull the Galley Light from the floor panels.

CLEANING

1. General
   Cleaning of the EEL system is straightforward and industry accepted practices should be used. This section highlights the special care that needs to be taken with respect to fragile parts and the materials used during cleaning.

CAUTION: DO NOT ALLOW ISOPROPYL ALCOHOL TO COME IN CONTACT WITH ANY OF THE LEXAN® COMPONENTS, INCLUDING THE TRACK BASE AND TRACK LENS ASSEMBLIES. SUCH CONTACT MAY PERMANENTLY DAMAGE LEXAN®, INCLUDING A DULLING OF THE TRANSPARENT COMPONENTS (SEE TABLE 401).

CAUTION: DO NOT USE HARSH CLEANING COMPOUND OR SOLVENTS AS THEY MAY FOG THE TRANSPARENT LENS OR LEAD TO CRYSTALLIZATION AND STRESS CRACKING OF THE LEXAN® COMPONENTS (SEE TABLE401).

CAUTION: DO NOT USE HIGHLY ALKALINE SOLUTIONS AS THESE MAY CAUSE THE LEXAN COMPONENTS TO DEGRADE;.

2. Clean EL Lamps
   Clean EL Lamps with a mild soap solution, applying with a slightly damp, clean, soft lint-free cloth.

   NOTE: EL Lamps may also be cleaned with Isopropyl Alcohol.

3. Clean LEXAN® Components
   Clean these parts with a mild soap solution, applying with a slightly damp, clean, soft lint-free cloth. Avoid excess moisture.
   The LEXAN® parts include Track Base, Track Lens, End Caps, Exit marker, Exit marker Lens and Power Supply Housings.
   Refer to Table 401 for compatibility.

4. Clean Fiber Glass Encapsulated Components
   Clean all fiber glass components with a mild soap solution, applying with a slightly damp, clean, soft lint-free cloth.
   The fiber glass encapsulated components are Galley Lights and Exit markers.

5. Clean Electrical Contacts
   Electrical contacts should not need cleaning for the life of the system.
   However, if it becomes necessary to clean contacts, clean with a small brush and Isopropyl Alcohol.
   Refer to Table 401 for compatibility.

6. Ultrasonic Cleaning

   CAUTION: PROLONGED OR UNCONTROLLED EXPOSURE OF ELECTRONIC SUB-ASSEMBLIES AND/OR SEMICONDUCTOR COMPONENTS TO ULTRASONICS CAN RESULT IN DAMAGE TO, OR DESTRUCTION OF SENSITIVE ELEMENTS.

   Exposure of complete assemblies, individual component assemblies and/or semiconductor devices such as the encapsulated inverter found in some EEL assemblies, to ultrasonic cleaning is not recommended.

CHEMICAL CLASS	EFFECT
ACIDS (Mineral)	No effect under most conditions of concentration and temperature. Generally compatible.
ALKALIS	Acceptable at low concentration and temperature. Higher concentrations and temperatures result in etching and attack, evidenced by decomposition.
ALIPHATIC HYDROCARBONS	Generally compatible.
AMINES	Avoid the use of this material. Surface crystallization and chemical attack.
AROMATIC HYDROCARBONS	Avoid the use of this material. Partial solvents and severe stress cracking agents.
DETERGENTS and CLEANERS	Mild soap solutions are compatible. Strong alkaline materials should be avoided.
ESTERS	Avoid the use of this material. Causes severe crystallization. Partial solvents.
GREASES and OILS	Pure petroleum types generally compatible. Many additives used with them are not. Thus, materials containing additives should be tested.
HALOGENATED HYDROCARBONS	Solvents. Avoid the use of this material.
KETONES	Avoid the use of this material. Causes severe crystallization and stress cracking. Partial solvents.
SILICONE OILS and GREASES	Generally compatible up to 85 °C (185 °F). Fluids should be tested, as some contain aromatic hydrocarbons.

Table 401: General Chemical Resistance of LEXAN® Polycarbonate Resins

CHECK

1. General
   Checking the EEL system can consist of both individual parts inspection as well as inspection on system level.

2. Check EEL System
   An overall System check can be accomplished by switching the cockpit ON/ARM/OFF switch at regular intervals determined by the airline operating the aircraft. See applicable aircraft manuals and checklist.

3. Check Power Supply
   See Testing and Fault Isolation (page 101) or individual CMM for each power supply (refer to IPC 33-50-05 for CMM part number).

4. Check Battery Pack
   Refer to CMM for battery pack (refer to IPC 33-50-05 for cross-reference of CMM part number).

5. Check Power Supply without Battery
   See individual CMM for each power supply (refer to IPC 33-50-04 for CMM part number) and Testing and Fault Isolation chapter.

6. Check Floor Track Housing
   Check track lens for any evidence of breakage or other damage.
   Replace broken or severely damaged floor track lens.

7. Check EL Lamp
   A. Check EL lamp for discoloring.
      Discoloring (typically turning grey) indicates that moisture has penetrated the EL lamp seal.
      Replace discolored EL lamps.

   B. Check EL Lamp connector pins.
      If connector pins are bent, carefully straighten connector pin.
      Replace EL lamp with broken connector pin(s).

   C. Check EL Lamp for sharp creases or cuts.
      Replace EL lamps with sharp creases or cuts.

8. Check Exit Marker
   A. Check EL Lamp inside exit marker for discoloring.
      Discoloring (typically turning grey) indicates that moisture has penetrated the EL lamp seal.
      Replace exit markers with discolored EL lamps.

   B. Check fiber glass exit marker for delamination.
      Replace severely delaminated Exit markers.

   C. Check exit marker wires.
      Check for damage of the wire insulating material. Repair any damaged or cut wires.
      Replace exit marker if wire is broken just after the exit marker button.

9. Check Galley Light

A. Check EL lamp(s) inside galley light for discoloring.
Discoloring (typically turning grey) indicates that moisture has penetrated the EL lamp seal.
Replace galley lights with discolored EL lamps.

B. Check fiber glass galley light laminate for delamination.
Replace severely delaminated galley lights.

C. Check galley light with button.
Check for damage of the wire insulating material. Repair any damaged or cut wires.
Replace exit marker if wire is broken just after the exit marker button.

D. Check galley light with ribbon cable.
Check for damage and cuts of the ribbon insulating material.
Replace the galley light with damaged ribbon cable.

REPAIR

1. General

The EEL system individual components are Line Replaceable Units (LRU), which are not line or shop repairable.

The EEL Power Supplies are repairable to a limited extent. See the respective Component Maintenance Manual for each power supply part number. IPC 33-50-05 provides a cross-reference list.

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ASSEMBLY AND INSTALLATION

1. General

The EEL system is a custom installed system within all aircraft types. The modular components can be fitted together in numerous configurations to form a complete emergency lighting system. The only component not common from aircraft to aircraft is the power supply. These must be matched to the aircraft electrical operation logic and input voltage requirements.

The following paragraphs describe the basic installation sequence of the EEL system.

2. Install Power Supply

A. Screw the power supply to the aircraft frame, power supply mounting brackets or interior panels.

B. Attach power supply connector to the aircraft's existing electrical emergency lighting system with a customer supplied wire harness.

NOTE: There are so many options for accomplishing aircraft wire connections and aircraft attachment that LSI does not normally supply these interconnect harnesses. Options include:

- installation of a dedicated electrical system when no electrical system currently exists.
- interconnection to existing power sources.
- interconnection to existing emergency lighting at local sources.

NOTE: Control over the system is accomplished by existing cockpit and/or cabin emergency lighting "ON/ARM/OFF" switches.

3. Install Floor Track Assembly - Preparation

A. Carpet

Cut carpet or mat one inch (25 mm) wide directly below the seat armrest and in other areas, i.e. cross-aisle, galley work area, and lavatory access area.

NOTE: Carpets with pre-stitched edges can also be used, however, compatibility with the flanged track should be verified.

B. Attach double-sided carpet tape to the floor panels where floor track and cables will be fitted.

C. Add .300 inch (mm) beyond track base length when using bull nose end cap.

4. Install Floor Track Base

CAUTION: REMOVE ALL BURRS AND SHARP EDGES AFTER CUTTING THE TRACK TO AVOID CABLE OR CABLE INSULATION DAMAGE.

NOTE: The flanged and non-flanged track base and lens can be used interchangeably. The flanged track base allows a wider surface area of adhesion to the floor panels. Narrow track base is 1 inch (25.4 mm) wide, flanged track base 1.5 inch (38.1 mm) wide.

NOTE: When direction changes in the track routing are necessary, such as for a cabin class change or monument circumvention, refer to paragraph 20. "Track Interruption with Lateral Shift" for additional information and recommended procedure.

A. Cut floor track base to the desired length with a miter saw. Cut straight across.

NOTE: Make sure that adjacent track bases are tightly butted together without a gap.

B. Notch the side wall and chamfer the track base 0.625 inches (13 mm) wide where the cable lead assembly or other ribbon cables will enter or exit the floor track (Figure 701).

NOTE: The notching method is not appropriate when the track butts up against a monument (galley structure, etc.).

C. Remove burrs and sharp edges present on track ends and notches. Electrical tape can also be placed over the cut area to insure protection from sharp edges.

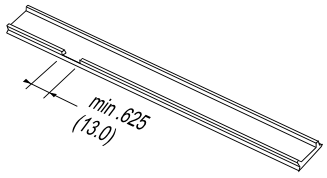

Figure 701: Side Wall Notch in Track

D. Attach the track to the double-sided carpet tape.

5. Install End Caps

A. Close the end of each track section using end caps by pushing the tab end of the end cap onto the track base and snapping it into place (Figure 702).

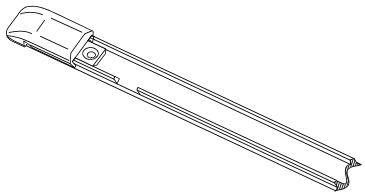

Figure 702: End Cap Installation

NOTE: For adhesion to the track base, remove the adhesive liner from the foam tape on the tab of the end cap.

NOTE: The end cap should be snapped onto the track base at the end of the track lens 0.75 ± 0.05 inches (19 mm ± 1.2 mm) onto the track base.

NOTE: The end cap may also be secured using the optional hole supplied. Use a #6 1/4 inch (6.4 mm) screw.

NOTE: The end cap with bull nose is intended for use on a hard surface.

6. Install Cable Track Assembly - Preparation

A. Place 4 inches (100 mm) of double-sided tape in the track base to hold cable to the track base where wire runs will enter or exit (Figure 703).

B. Put double-sided carpet tape on the floor outside of the track base where ribbon cables run to secure them to the floor panels (Figure 703).

C. Attach 2 to 3 inches (50 to 75 mm) of clear double-sided tape inside of the track base housing every 3 feet (0.9 m) and remove the adhesive liner. The tape will serve to hold down the cable track assembly.

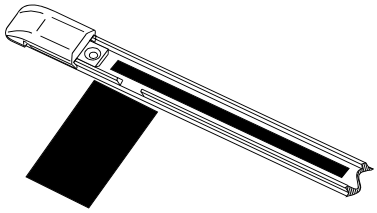

Figure 703: Preparation for Cable Installation

NOTE: Double-sided carpet tape can be applied at cable entrances and where the cables attach to the connectors.

7. Install Flat Ribbon Cable

A. Cable Types

This procedure is applicable to the various types of Cable Track Assembly, Cable Lead Assembly and Jumper Cable Assemblies.

B. Cable Handling (Figure 704)

To correspond with installation requirements, the cable track assembly may be:

(1) folded onto itself to achieve 90° turns ('Reverse Corner Fold') or to adjust the spacing between two connector pairs ('Z-fold')

(2) cut, to adjust the length of the cable track assembly. Always place electrical tape over the exposed end of the cut cable.

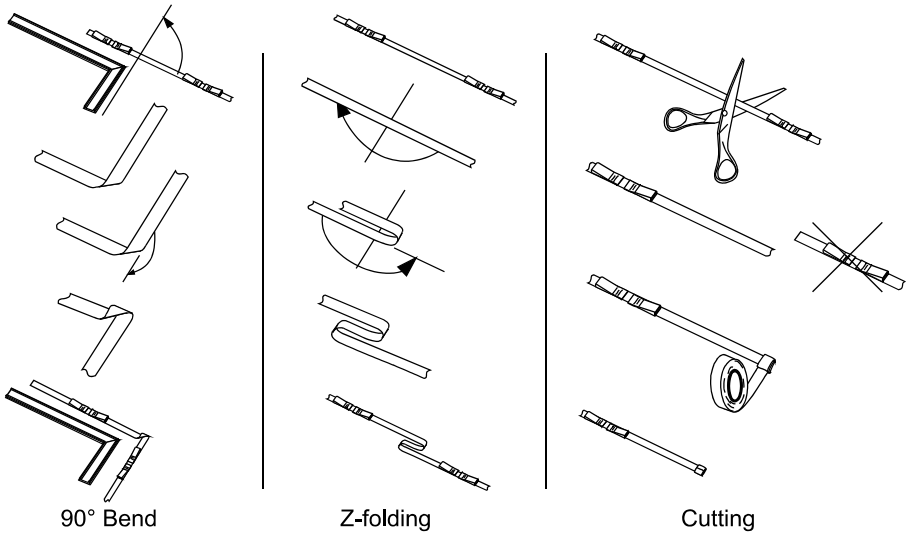

Figure 704: Flat Ribbon Cable Handling

C. Cable Installation

CAUTION: THE CABLE TRACK ASSEMBLY SHOULD NOT BE REPEATEDLY BENT OR CREASED SHARPLY.

(1) Attach cable lead assembly to cable track assembly.

(2) Install barbed clamp onto cable lead and cable track assembly connectors.

(3) Install optional Sealing Kit (procedure described in paragraph 23. “Moisture Protection Measures - Sealing Kit”).

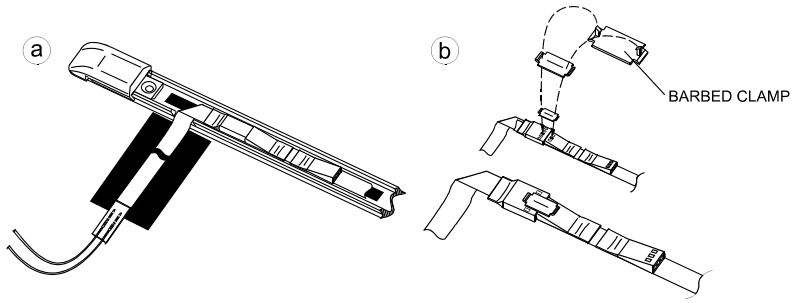

Figure 705: Cable Track Installation - Barbed Clamp

(4) Attach cable lead assembly to floor panels with double-sided tape (Figure 705).

(5) Interconnect lighting assemblies of the same power supply with jumper cables as appropriate.

8. Install EL lamps

CAUTION: DO NOT CUT THE FLEXIBLE EL LAMPS.

CAUTION: TO AVOID FAILURE OR SHORT CIRCUIT, EL LAMPS SHOULD NOT BE BENT AT A RADIUS LESS THAN 1 INCH (25 MM).

CAUTION: DO NOT BEND OR DAMAGE THE CONNECTOR PINS WHILE HANDLING OR INSERTING THE CONNECTOR.

CAUTION: REMOVE ADHESIVE LINER FROM TAPE AND ADHESIVE TABS ATTACHED TO THE BACK OF EACH LAMP BEFORE INSTALLING.

NOTE: When the optional sealing kit is to be installed, refer to paragraph 23. “Moisture Protection Measures - Sealing Kit” for assembly instructions.

A. Position the EL lamps above the cable track assembly running along the track base. The EL lamps have strips of adhesive on the back to ensure that they remain in position once they are connected.

B. Plug the individual EL lamps into the sockets on the cable track assembly (Figure 706).

NOTE: Make sure that the connector is fully inserted before seating the adhesive tape on the back of the EL lamp to the cable track assembly.

C. Install barbed clamp onto EL lamp and track cable connector for optimum lamp retention.

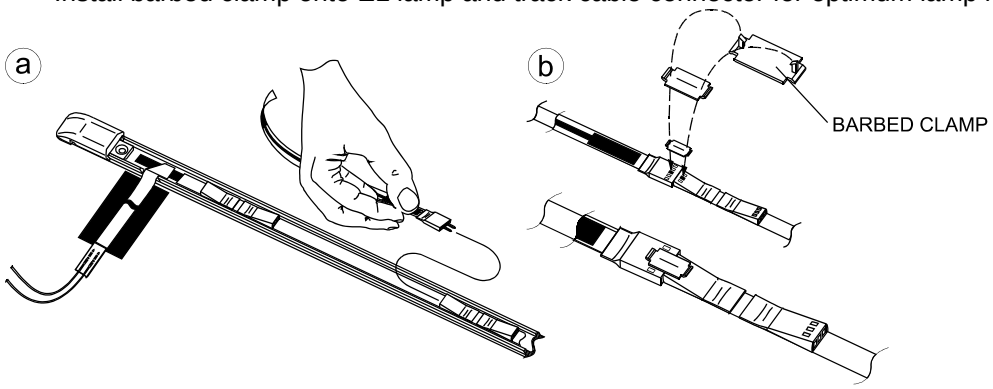

Figure 706: EL Lamp Installation - Barbed Clamp

D. Ensure that all connections are securely made and press the adhesive areas to ensure attachment.

E. Apply electrical power to the system. Verify that all the EL lamps are operational, then turn power off.

9. Install Cable Cover

A. Cut and attach cable covers over all external ribbon cables (Figure 707).

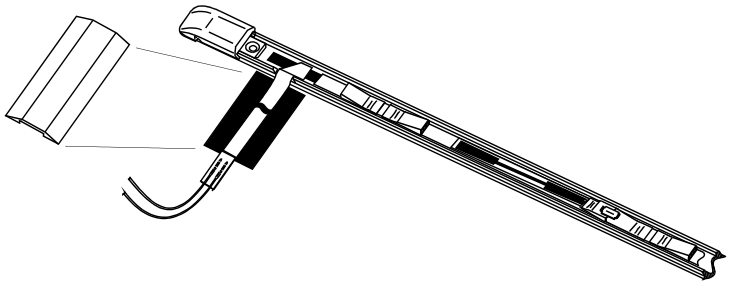

Figure 707: Cable Cover Installation

10. Install Carpet

Procedure is straightforward.

NOTE: Leave a 0.040 inches (1 mm) gap between track base and the carpet edge. This is necessary as the track lens snaps over the outside of the track base.

NOTE: When the flanged track lens is used, the carpet is to be installed before the track lens is fitted. When the narrow track lens is used, carpet can be fitted when the EEL system has been fully installed.

11. Install Track Lens

NOTE: Avoid electrical connections/connectors directly underneath track lens butt-joints. Offset the location of electrical connections from any base or lens butt joint by at least a minimum of 4 inches (100 mm) if possible. The use of a sealing kit (see paragraph 23.) in these areas is highly recommended.

NOTE: Do not let track base and track lens butt-joints coincide. Offset track lens butt-joints from track base butt-joints by a minimum of 4 inches (100 mm).

A. Lay track lens along the length of the track base.

NOTE: To protect against moisture ingress, RTV sealant can be applied at all end cap and track base intersections, and to all ribbon cable exit locations of the track base (Figure 708).

NOTE: Only use non-acetic or alcohol based curing RTV (non-corrosive for electrical installations).

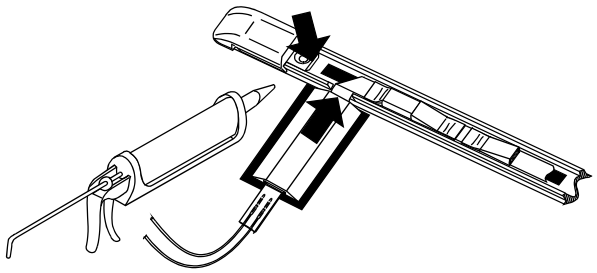

Figure 708: Application of Silicone Sealant

B. Starting at one end of the housing (usually at an end cap or at track-to-track butt-joints of the lens), hook one side or leg of the track lens to the mating side or leg of the track base section (Figure 709). Position tight to end cap or adjacent track lens.

C. Apply pressure on the opposite edge of the track lens until that area snaps down and becomes secure to the track base.

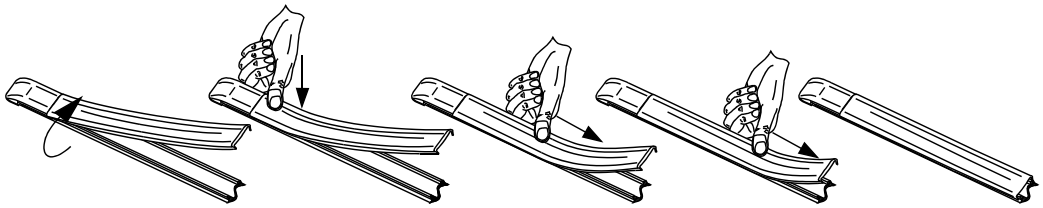

Figure 709: Installation of Track Lens

D. Continue applying pressure at short intervals, 2-4 inches (50-100 mm), working along the entire length of the track lens.

E. At the end of the installation (at another end cap or a butt joint) mark and cut the track lens to the appropriate size. Remove any burrs or sharp edges.

NOTE: Make sure that the track lens is cut straight at butt joints.

F. Snap the final section of the track lens into place.

G. Immediately remove squeezed out excess RTV sealant.

H. Check the entire length of the section (both sides) to ensure that the track lens is completely snapped onto the track base.

12. Determining Suitable Locations for Galley Lights

CAUTION: INSTALL GALLEY LIGHT AND RIBBON CABLE IN A PROTECTED AREA IN THE GALLEY, THIS IS CLOSE TO MONUMENTS, AND OUTSIDE OF GALLEY CART PIVOT AND TRAFFIC AREAS.

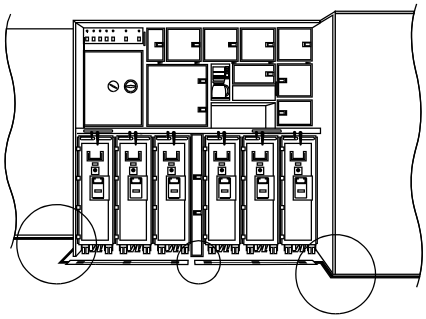

Figure 710: Location of Galley Light

A. Galley Light Location
In order to protect the galley light from direct damage, it should be located as close to the galley structure as practicable. If at all possible, it should not be placed in front of galley trolley stowage areas.

B. Galley Light ribbon cable entry point
This area of the galley lights is particularly fragile and requires the most attention. Ideal location is out of traffic areas in general and out of pivot areas from galley trolleys in particular.

C. Ribbon Cable Routing
Straight sections and 90° bends of the ribbon cable especially should be routed as close as possible to areas where there is minimal traffic. Whenever possible, use the cable cover for protection.

D. NTF Delamination
Non-textile flooring (NTF) delamination is typically caused by galley trolley traffic. When the seal around the galley light between the galley light edge and NTF gets damaged or worn, liquids may enter the gaps. Both galley light and NTF may detach from the aircraft floor panels, causing failures of or damage to the galley light or its ribbon cable.

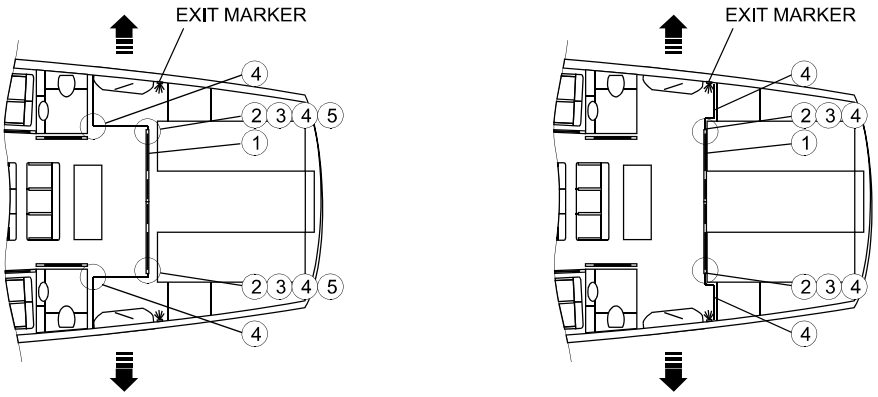

Figure 711: Improper (Left) and Proper (Right) Galley Light and Cable Installation

13. Install Galley Light Connected to Aircraft Wire Harness

The ribbon cable of the galley lights for this type of installation terminate in either (1) round wires or (2) round wires and a connector.

CAUTION: INSTALL GALLEY LIGHT AND RIBBON CABLE IN A PROTECTED AREA, THIS IS AS CLOSE TO MONUMENTS AS POSSIBLE. AVOID PIVOT AND TRAFFIC AREAS OF GALLEY CART WHEELS.

A. Clean area with a clean cloth.

B. Attach double-sided carpet tape to the floor panels where the galley light and the galley light lead will be located.

NOTE: In galley areas better adhesion can be accomplished by applying high-bond aluminum aircraft tape to the galley floor before attaching the double-sided carpet tape.

C. Position galley light over double-sided carpet tape.

D. Press galley light down firmly for good adhesion.

E. Attach galley light lead to the double-sided carpet tape.

F. Cut and attach cable covers over all external ribbon cables (optional).

G. Install non-textile floor covering.

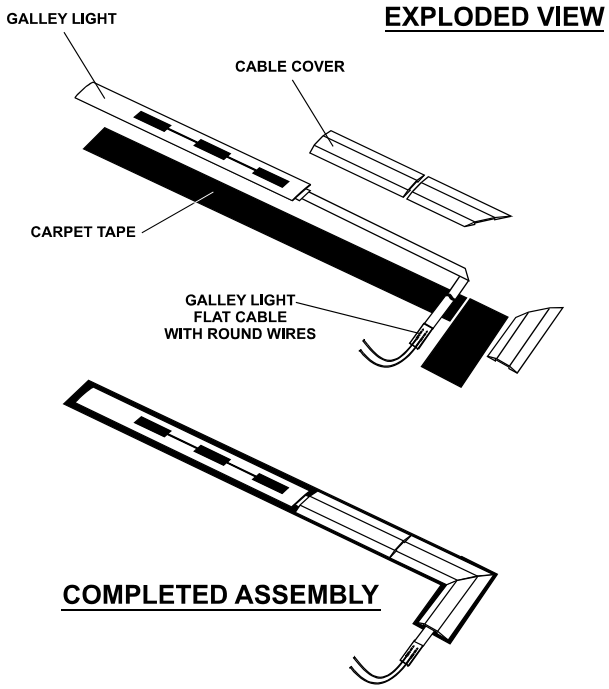

Figure 712: Galley Light connected to Aircraft Wire Harness

H. Connect galley light to aircraft wire harness located behind bulkhead or inside monuments.

I. Optional: seal galley light around the edges at joint with NTF with non-acetic curing RTV for added protection against moisture.

14. Install Galley Light Connected to Cable Track Assembly

A. Scope

Galley lights for this installation terminate in ribbon cable with a cable track assembly compatible connector.

CAUTION: INSTALL GALLEY LIGHT AND RIBBON CABLE IN A PROTECTED AREA, THIS IS AS CLOSE TO MONUMENTS AS POSSIBLE. AVOID PIVOT AND TRAFFIC AREAS OF GALLEY CART WHEELS.

NOTE: The end caps suitable for this installation are the end caps with nose flange (in combination with narrow track lens) and the end caps with full flange (in combination with flanged track lens).

B. Installation Sequence

(1) Notch the end of the track, chamfer the bottom of the base and remove burrs and sharp edges present on the track end. Electrical tape can also be placed over this area as additional protection from sharp edges.

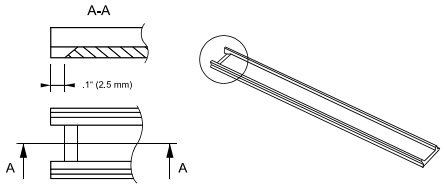

Figure 713: Notched + Chamfered Track End

(2) Clean floor panel area with a clean cloth.

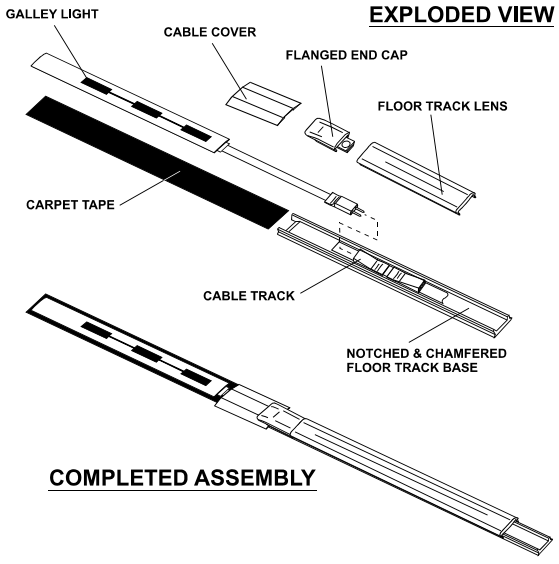

Figure 714: Galley Light connected to Cable Track Assembly

(3) Attach double-sided carpet tape to the floor panels where the galley light and the galley light lead will be located (Figure 714).

(4) Plug galley light connector into cable track assembly.

(5) Attach galley light lead to the double-sided carpet tape.

NOTE: The sealing kit should also be applied at this moment (see instructions in paragraph 23.).

(6) Position galley light over double-sided carpet tape.

(7) Press down firmly for good adhesion.

(8) Cut and attach cable cover(s) over all external ribbon cables.

NOTE: If the galley is butted directly to the track base, cable cover is not needed.

C. Install carpet or non-textile floor covering.

D. Optional: seal galley light around the edges with RTV for added protection against moisture.

15. Install Galley Light Connected through Floor Panel

A. Scope

Galley lights for this installation have round wires coming out of the back of the part through a "button".

B. Installation Sequence

(1) Clean area with a clean cloth.

(2) Attach double-sided carpet tape to the floor panels where the galley light will be located (Figure 714).

(3) Drill a suitable size hole through the aircraft floor panel. The hole size depends on the type of button on the back of the galley light.

(4) Feed galley light wires through hole and connect to aircraft wire harness.

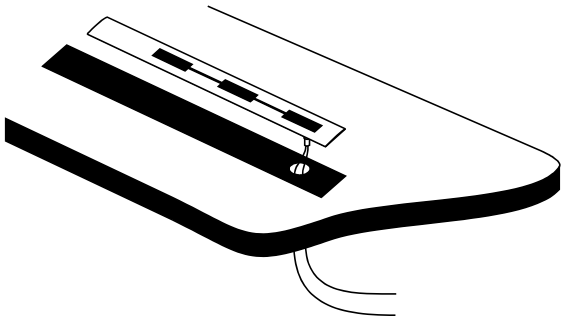

Figure 714: Galley Light connected through Floor Panel

(5) Position galley light over double-sided carpet tape.

(6) Press down firmly for good adhesion.

(7) Connect galley light leads to aircraft wire harness.

(8) Optional: seal galley light around the edges with RTV for added protection against moisture.

16. Install LEXAN® Exit markers
    A. Connect wires or plug exit marker connector into aircraft wire harness connector.
    B. Pass exit marker wires/connector through aircraft trim/bulkhead.
    C. Install fasteners. Procedure is straightforward.

17. Install Fiber Glass Exit markers without Mounting Holes
    A. Attach double-sided carpet tape to interior trim panels.
    B. Connect wires or plug exit marker connector into aircraft wire harness connector.
    C. Pass exit marker wires/connector through aircraft trim/bulkhead.
    D. Position exit marker over double-sided carpet tape.
    E. Press down firmly for good adhesion.

18. Install Fiber Glass Exit markers with Mounting Holes
    A. Attach double-sided carpet tape to interior trim panels (optional).
    B. Connect wires or plug exit marker connector into aircraft wire harness connector.
    C. Pass exit marker wires/connector through aircraft trim/bulkhead.
    D. Position exit marker over double-sided carpet tape (optional).
    E. Press down firmly for good adhesion (optional).
    F. Install fasteners. Procedure is straightforward.

19. Cable Exit under End Cap

A. Reason

This alternative is recommended for flat ribbon cable installations (instead of track notching), typically when the track butts up against a monument (galley structure, toilets, etc.). Rather than exiting through a notch in the track leg (by first removing the track leg), the cable exits underneath the end cap. From then on, the installation sequence is similar to the notched track installation.

B. Installation sequence

(1) Install track system (except for the lens, end cap and cable cover) at the proper location

NOTE: Make sure to notch the end of the track, chamfer the bottom of the base and remove burrs and sharp edges present on the track end. Electrical tape can also be placed over this area as additional protection from sharp edges.

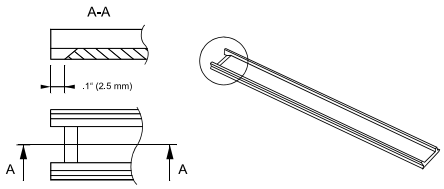

Figure 715: Notched + Chamfered Track End

(2) Install cable cover, end cap and track lens.

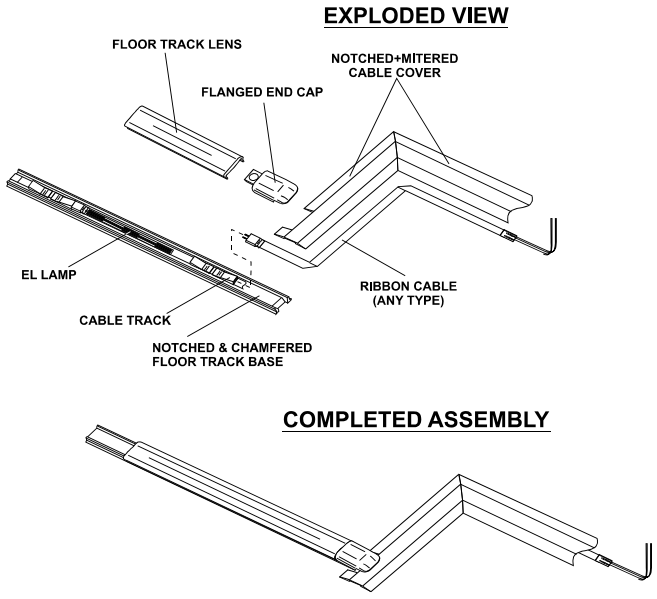

Figure 716: Installation with Cable Exit under End Cap

20. Track Interruption with Lateral Track Shift

A. Reason

Cabin seating class changes and the presence of monuments are often the cause of an interruption in the normally continuous track system: the track needs to be terminated at some point, and continues alongside the monument. Quite often, both track sections are part of the same electrical circuit and need to stay interconnected.

The displacement between these two sections of track is called a lateral track shift. The following installation uses a double-notched cable cover. This solution offers installation flexibility and does not require cable cover adjustment or cutting and mitering during installation on the aircraft. The notches in the cable cover can be prepared in the shop where the required tools and machinery are available.

B. Installation sequence (Figure 717)

(1) Notch the ends of the cable cover on opposite sides.

NOTE: The distance between the respective center of the notches corresponds to the nominal displacement to be covered. The notches are to be 2 inches (50 mm) wide when the narrow track base is used, and 2.5 inches (63 mm) when flanged track base is used. The notch should extend 0.04 inch (1 mm) into the center channel of the cable cover to allow clearance for the flat cable.

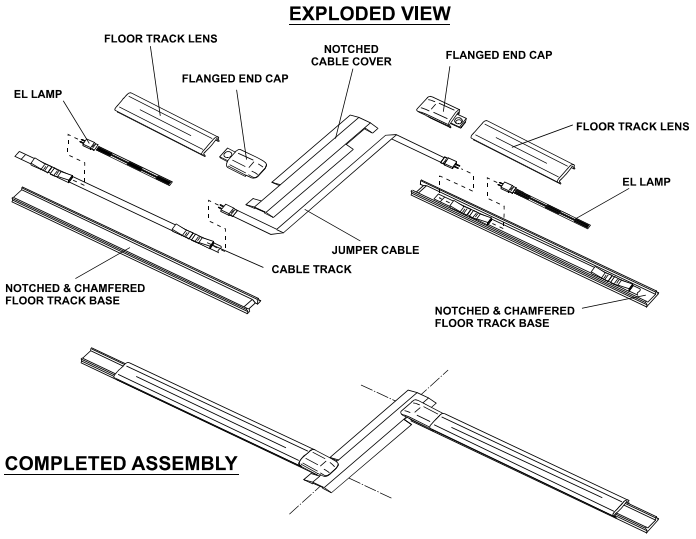

Figure 717: Track Interruption with Lateral Track Shift

(2) Install both track systems (except for the lens, end caps and cable cover) at the proper displacement. When the lateral shift is too large to be covered by the cable track assembly, use a jumper cable.

NOTE: Make sure to notch and chamfer both pieces of track base at the ends facing one another (see Figure 716).

(3) Install the notched cable cover, end caps and both track lenses.

21. Fuselage Narrowing and Lateral Track Rotation (Aircraft Tail)

A. Reason

The fuselage of most aircraft narrows down from some point near the end of the cabin. As a result, the center seats go to one seat less abreast to compensate for the outboard seats which are rotated inwards over a small angle (typically <5°) towards the aircraft center line.

The EEL system needs to remain visible at all times and thus the track, when fitted along the outboard seats, is required to follow this inward rotation. The electrical installation in many situations may not be interrupted as both sections are part of the same electrical circuit.

B. Installation Sequence (Figure 719):

(1) Install both track systems (except for the lenses, end caps and cable cover) along the outboard seats under the required angle at a distance of 1-2 inches (25-50 mm).

NOTE: Make sure to notch and chamfer both pieces of track base at the ends facing one another (see Figure 716).

(2) Install an appropriate length of cable cover in between both track bases, followed by both end caps and finally both track lenses.

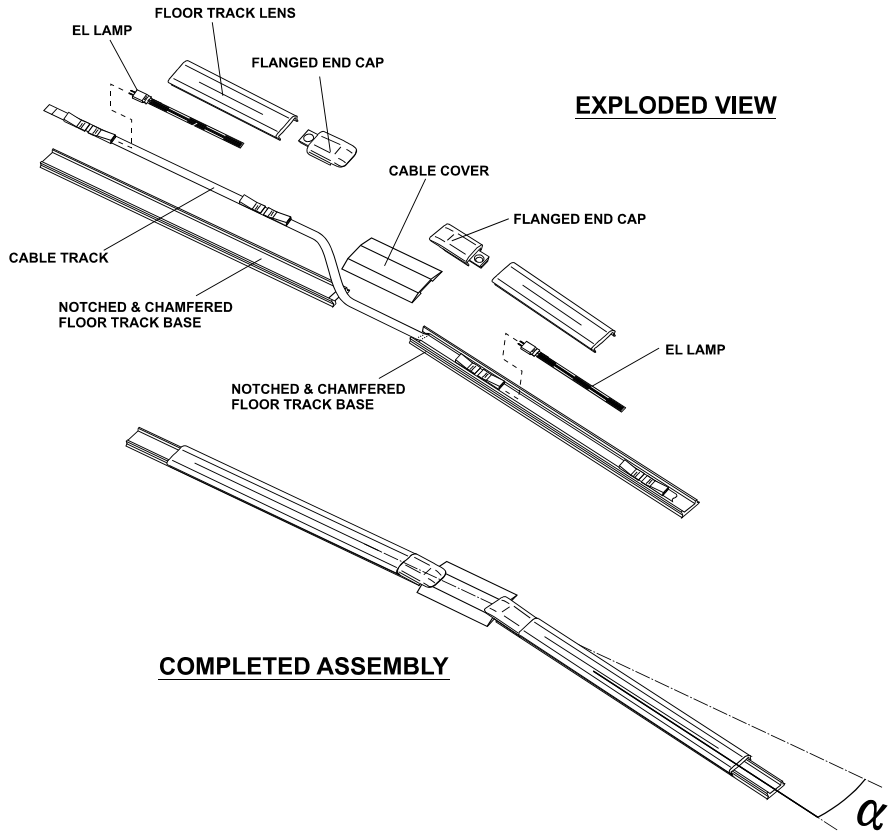

Figure 719: Fuselage Narrowing and Lateral Track Rotation

22. Moisture Protection Measure - Reverse EL Lamp Installation

A. Reason

To avoid cable track connectors near the ends of track runs which are typically located close to areas where excess humidity is present, the EL lamp can be fitted in the opposite direction from the other lamps. As a consequence, the environmentally sealed “tail” of the EL lamp is located at the end cap rather than at the cable connector. This is referred to as the “reverse” EL lamp installation.

B. Installation Sequence

(1) Insert the EL lamp closest to the end cap in the opposite connector of the last connector pair on the flat cable.

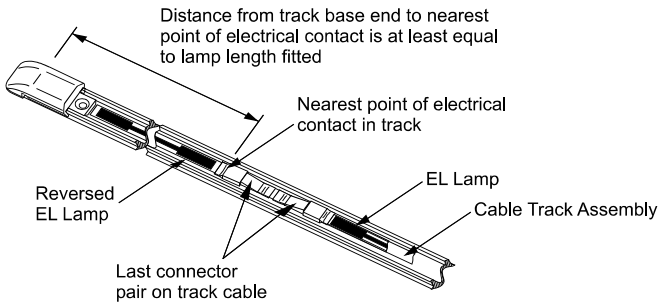

Figure 720: Reverse EL Lamp Installation

23. Moisture Protection Measure - Sealing Kit Installation

As an alternative to the application of RTV silicone sealant to prevent moisture from entering the track system, a silicone gel sealing kit can be applied to all exposed cable connections in the vicinity of galley and toilet areas, cable entry areas into the track, floor track joints, and end caps locations.

This procedure is suggested to seal the floor proximity emergency exit light connector from excessive environmental contaminants such as water, beverage spills, overflowing lavatories, cleaning detergents, etcetera.

NOTE: In order to provide optimal protection, all connectors, both those with lamps connected and those without lamps connected must be wrapped. Every connector in the entire system must be sealed in order to provide maximum protection against moisture penetration.

NOTE: The sealing kit can be applied at all locations where the presence of moisture may be expected, for example at exit/entry/service doors, galleys and toilets.

NOTE: The use of this material on FPEEPMS electrical connections outside the floor track housing is strongly encouraged. Connector to galley light strips, exit markers and inter-cable connectors are appropriate areas of application for this material.

A. The Sealing Kit contains the following parts:
   (1) one large silicone gel sealing pad
   (2) two small silicone gel sealing pads
   (3) decorative overlay cover strip.

   NOTE: Different kit types exist with respect to the decorative overlay color. Kit types should not be mixed on an aircraft.

   NOTE: One connector seal kit is required for each pair of opposing connectors on the floor path marking ribbon cable contained in the floor track housing.

   NOTE: Each connector seal kit is estimated to require 1 minute to install.

B. In retrofit installations, remove all tapes around the EL lamp and cable connectors onto which the sealing kit will be installed.

C. In retrofit installations, Install a small square gel piece on back of lamp from edge of connector toward other end of lamp. Remove release paper on both sides (Figure 721).

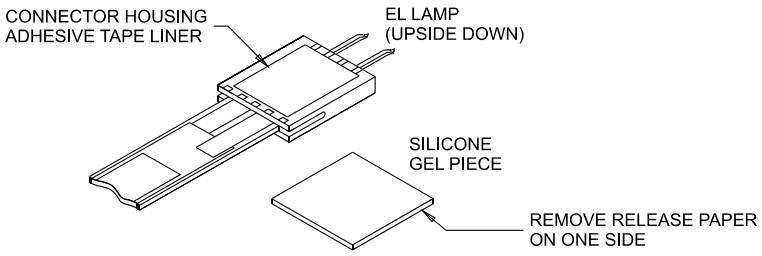

Figure 721: Preparation of Male Connector

D. Remove adhesive tape liner from all pieces of tape on the back of the lamp.

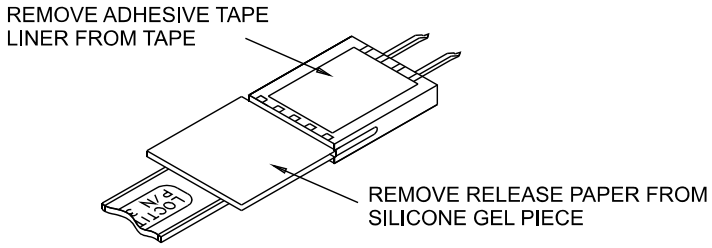

Figure 722: Remove Adhesive Liner

E. Assemble lamp to cable. Insert connector pins into socket housing on cable. Firmly press pin housing against cable so adhesive tape makes good contact with cable. Press remainder of flex lamp against cable so adhesive tape adheres well to flex cable.

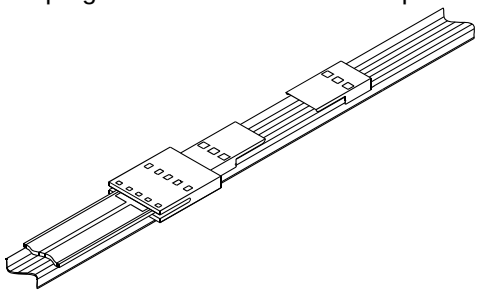

Figure 723: Assemble Lamp to Cable

F. Install sealing cover piece

(1) Remove paper backing (Figure 724).

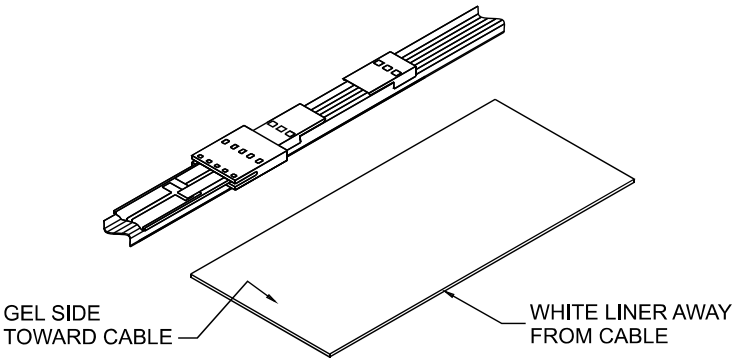

Figure 724: Sealing Cover Preparation

(2) Center material under connector area, with gel material face up toward bottom of cable, white lining material face out. Center material so that both connectors, if there, are covered.

(3) Align long edge of material with edge of cable (Figure 725).

(4) While keeping slight tension on the tape, roll or crimp sealing tape around connector area. Motion is similar to rolling a cigarette.

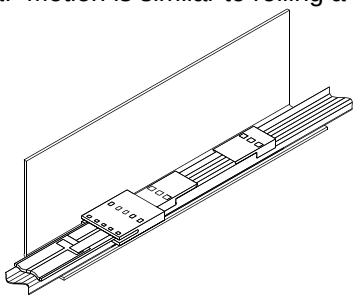

Figure 725: Cover Piece Installation

(5) Firmly press gel material onto connector and cable area. Press tape smooth over entire area. Be sure to press out any trapped air. Ensure that lamp is connected to flex cable.

(6) Continue wrapping material around cable. Terminate edge on bottom.

G. Install in track housing

(1) Lay wrapped connector in floor track base.

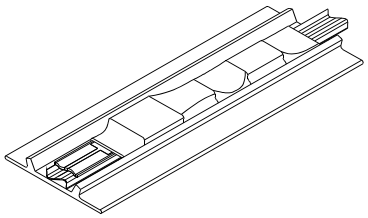

Figure 726: Wrapped Connector Installation

(2) Place decorative cover piece over connector area.

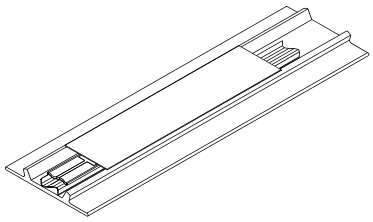

Figure 727: Decorative Cover Piece Positioning

(3) Snap cover on. Fit will be tight.

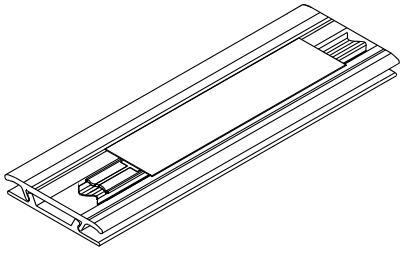

Figure 728: Installed Sealing Kit

24. Aisle Lower than Seat Floor

In small commuter aircraft, the aisle is sometimes recessed to provide more cabin height. In such cases, the track or galley light path lighting system can be mounted in a recess on one of the rising sides of the aisle path with the lighting serving as floodlighting (Figure 729-a). When the extrusion can be part of the seat rail, it can be designed such that the lighting is fitted facing upwards on the corner of the recessed aisle (Figure 729-b).

The sketches below are not to scale and show suggested position and orientation of the track lighting system.

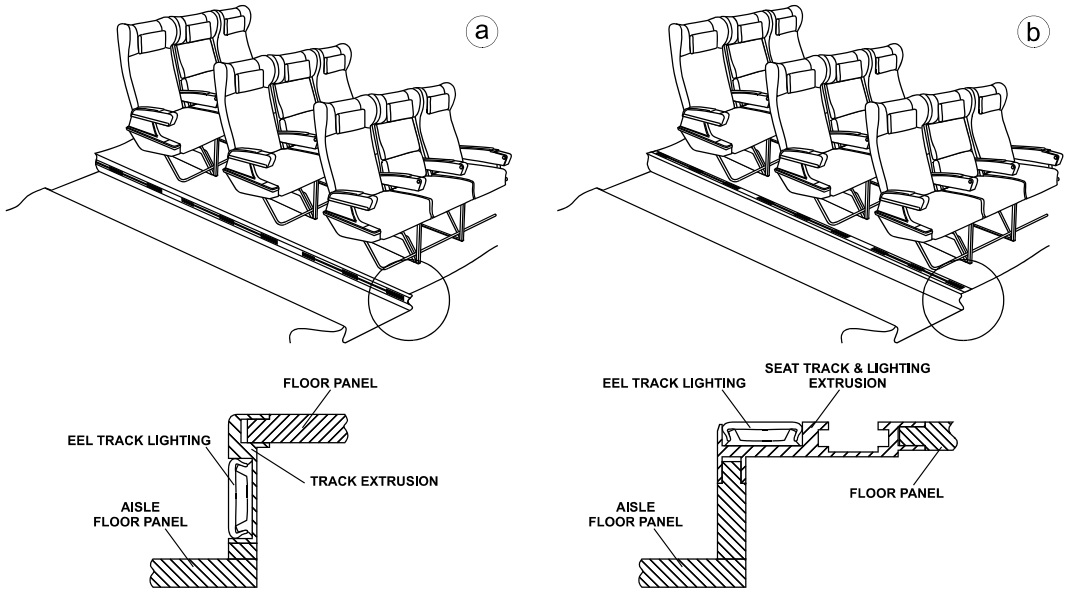

Figure 729: Location of FPEEPMS in Recessed Aisle

25. Check List for Proper System Installation

When the LSI EEL System is properly installed, there is minimal opportunity for damage caused by passenger traffic.

A. Wire Harnesses and Flat Cables
   (1) Cables and harnesses should be protected at sharp edges on wall panels and floor track entry points.
   (2) Flat cable folds should be made out of traffic areas, i.e. under seats or near walls.
   (3) Flat cables should be secured with double-sided tape at connections and folds onto the cable track assembly.
   (4) Barbed clamps are to be used to secure lead and jumper cable connectors to the cable track connectors.

B. Cable Covers
   (1) Cable covers should be used to protect all cables which lay outside of the protective floor track.
   (2) Cable covers should be installed tightly against the floor track or wall panels to prevent cable cutting by the carpet knife.
   (3) Cable covers also protect against damage from seat legs during installation or removal.

C. EL Lamp
   (1) EL lamps should not be cut to length.
   (2) Ensure that the pins are seated well into the cable track assembly sockets.
   (3) Check that the EL lamps are secured to the cable track assembly via the attached adhesive tape.
   (4) Barbed clips are to be used to secure the EL Lamps to cable track connectors.

D. Floor Track
   (1) Floor track base and lens joints should be offset.
   (2) Track lens joints should be at least 4 inches (100 mm) from all electrical connections, otherwise the use of the sealing kit is recommended.
   (3) Joints should be cut straight and smooth, free of rough edges.
   (4) Cuts should be made pependicular to the mating part face.
   (5) Track lens end should be cut 3/4 inch ± 0.040 (19 mm ± 1 mm) shorter than the track base to allow for secure attachment of end caps.
   (6) Pieces of floor track shorter than 1 foot (300 mm) should not be used.

E. End Caps
   (1) End caps should be snapped securely 3/4 inch (19 m) onto the floor track base.
   (2) An adhesive foam tape is also provided to ensure attachment.
   (3) Ensure that the track lens is cut straight to allow for a tight joint.

F. Encapsulated Lights
   (1) Encapsulated lights (galley lights, exit markers) should be installed in heavy traffic areas, galley, lavatory or entry areas where moisture can be present.
   (2) Ensure that the cables are protected with cable covers.
   (3) Ensure that all cable connections or splices are out of wet areas.

26. Storage

A. Power supplies.
See latest revision of respective power supply CMM. Refer to Publication Index LSI #95373 for cross-reference.

B. Batteries.
See latest revision of battery CMM. Refer to Publication Index LSI #95373 for cross-reference.

C. EL lamps.
EL lamp storage parameters:
(1) dark area
(2) < 20% RH
(3) 21.0 °C ± 3.0°C (70 °F ± 5.0 °F)
After two (2) years of storage under these conditions, EL lamps shall meet all LSI requirements for new parts.

D. Fiber glass encapsulated galley Lights and exit markers.
Fiber glass encapsulated galley light and exit marker storage parameters:
(1) dark area
(2) < 20% RH
(3) 21.0 °C ± 3.0°C (70 °F ± 5.0 °F)
After two (2) years of storage under these conditions, the parts shall meet all LSI requirements for new parts.

E. LEXAN® housed exit markers.
Exit marker storage parameters:
(1) dark area
(2) < 20% RH
(3) 21.0 °C ± 3.0°C (70 °F ± 5.0 °F)
After two (2) years of storage under these conditions, exit markers shall meet all LSI requirements for new parts.

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FITS AND CLEARANCES

1. General

The fits and clearances data of the EEL system components can be found in the Illustrated Parts Catalogues (IPC) referenced at the beginning of this manual.

The IPC references the weight, installation related dimensions and electrical characteristics of each component.
The weight data may be desired in order to obtain total system weight as installed in an aircraft, whereas the dimensions and electrical characteristics of each of component are necessary to:

A. determine correct location of the aisle lighting components to meet FAA/CAA regulations,
B. foresee space for the exit markers in or on bulkheads,
C. determine a location of suitable size for the power supplies in the aircraft.
D. determine the quantity of power supplies in the aircraft as a function of their load.

2. In-service Wear

None of the parts manufactured by Luminescent Systems, Inc. show "in-service wear".

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SPECIAL TOOLS, FIXTURES AND EQUIPMENT

1. General
In addition to common hand tools and standard workshop equipment, some special tools and equipment are required for the disassembly, inspection, repair, replacement, and/or reassembly of some components.

2. Tool List
No special tools are required for equipment other than for connectors. These tools are listed in IPC 33-50-12.

3. Fixtures List
No special fixtures are required for equipment other than for Power Supplies or Batteries.

For specific information on Batteries and Power Supplies, see the latest revision of the Component Maintenance Manual corresponding to the Power Supply or Battery part number.
Refer to Publication Index LSI #95373 for a cross-reference of CMM and part numbers.

4. Equipment List

Type	Part Number	Manufacturer
Multimeter Input Impedance: 10 MΩ DC Voltage: up to 1000VDC AC Voltage: up to 750VAC Resistance: up to 20 MΩ	8024-B or equivalent	John Fluke Mfg. Co., Inc. PO Box C-9090 Everett, WA 98206 USA
Digital Multimeter Sensitivity 1 µV up to 300V True RMS Bandwidth: 20Hz up to 100kHz DC Voltage: up to 300VDC AC Voltage: up to 300VAC Current: up to 3A	HP 3468A or equivalent	Hewlett Packard Co. 1820 Embarcadero Road Palo Alto, CA 94303 USA

Table 901: List of Equipment

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APPENDIX A: AOG PROCEDURES

1. Requirement

The ATA Airline Suppliers Guide requires that "suppliers make every effort to ship AIRCRAFT ON GROUND (AOG) material within 4 hours of request and to ship other critical material within 24 hours. For these purposes, suppliers will need to operate 24 hours a day, 7 days a week".

2. General Approach

A. LSI has established a 24 hour telephone number to take any AOG call, or other emergency after office hours.

LSI AOG PHONE NUMBER: +1 802 295 0408

The operator will take:
(1) callers name
(2) airline name
(3) telephone number
(4) any message that the caller wishes to leave.

The operator will then pass the message to the appropriate individual within LSI. It will be the responsibility of this individual to:
(5) call the airline back
(6) get all pertinent information (see list below)
(7) take the necessary AOG action required to get the necessary parts shipped.

B. LSI requires the following information from the caller for prompt and correct action:
(1) callers name
(2) airline name
(3) telephone number
(4) date and time of call
(5) part number(s)
(6) material quantity
(7) aircraft type
(8) purchase order n°
(9) ship to address
(10) bill to address
(11) special instructions.

C. AOG Shipment.
(1) Federal Express (Fedex) is the best method of shipping from Lebanon, New Hampshire. Fedex:
  (a) leaves Lebanon with packages received before 6:30 p.m.
  (b) ships late packages the following evening
  (c) provides no service out of either Lebanon, NH or Boston, MA on Sundays or holidays.
(2) Local airlines offer counter to counter service which interconnect to major carriers. This service is available daily from Lebanon, NH at an extra service fee. Last drop off time at FedEx in Lebanon, NH is 6.15 pm.
(3) Please specify clearly which shipping method is preferred.

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APPENDIX B: FAA ADVISORY CIRCULAR

1. Description
   The integral text of FAA Advisory Circular 25.812-1A, Floor Proximity Emergency Escape Path Marking is listed for reference on an informational basis.

2. FAA Advisory Circular AC N° 25.812-1A, 22 May 1989

U. S. Department of Transportation

Federal Aviation Administration

Advisory Circular

Subject: FLOOR PROXIMITY EMERGENCY ESCAPE PATH MARKING

Date: 5/22/89 **AC No:** 25.812-1A

Initiated by: ANM-110

1. PURPOSE. This advisory circular provides guidance material for use in demonstrating compliance with the provisions of Part 25 of the Federal Aviation Regulations (FAR) requiring floor proximity emergency escape path markings. Like all advisory circulars, it is not regulatory but is to provide guidance for applicants in demonstrating compliance with the objective safety standards set forth in the rule.

2. CANCELLATION. AC 25.812-1, Floor Proximity Emergency Escape Path Marking, dated September 30, 1985, is canceled.

3. RELATED FAR SECTIONS.

a. Section 25.812, Amendment 25-58, of Part 25 of the FAR - Emergency Lighting.

b. Section 121.310, Amendment 121-183, of Part 121 of the FAR - Additional Emergency Equipment.

4. BACKGROUND.

a. As part of the Federal Aviation Administration's (FAA) continuing efforts to upgrade aircraft cabin safety and improve occupant survivability in aircraft accidents, the agency has examined numerous factors which may affect the ability of passengers to quickly and safely evacuate airplanes in emergency situations. One factor which has been shown to be significant is that smoke in a post crash fire can obscure overhead emergency lighting, making cabin evacuation difficult. The FAA has conducted research, testing, and design studies, and undertaken rulemaking relating to the concept of placing additional sources of emergency lighting at a lower level, in the relatively clear air near the cabin floor.

b. Following public rulemaking, Amendments 25-58 and 121-183 (49 FR 43182; October 26, 1984) were issued, establishing requirements for floor proximity emergency escape path marking which will provide visual guidance for emergency cabin evacuation when all sources of cabin lighting more than four feet above the aisle floor are totally obscured by smoke. These amendments make the standards applicable to future type certification of transport category airplanes and require that airplanes type

certificated after January 1, 1958, and operating under Part 121 (air carrier) of the FAR be equipped with a system meeting these standards by November 26, 1986.

5. OBJECTIVE OF THE RULE.

a. Research and studies conducted by the Federal Aviation Administration prior to the issuance of the rule included analyses of a number of systems utilizing point lighting, flood lighting, strip lighting, markers, signs, reflective materials, and other marking methods. Since no system was shown to be so clearly superior to the others that it warranted establishment through regulation as the single standard, an objective performance standard was developed, rather than a standard which would require a particular type of system.

b. Floor proximity marking is intended to allow passengers who have become familiar with the cabin layout during the period of general overhead illumination prior to an accident to find their way to exits unassisted, should the general overhead illumination become obscured by smoke. This objective is stated in the rule as two separate requirements. The first is that the emergency escape path marking will enable each passenger to visually identify the emergency escape path along the cabin aisle floor after leaving the cabin seat, and the second is that the marking will enable each passenger to readily identify each exit from the emergency escape path by reference only to markings and visual features not more than four feet above the cabin floor. In both cases it is assumed that all sources of illumination more than four feet above the cabin aisle floor are totally obscured and that it is dark.[1]

---

[1]The applicable portions of Section 25.812 of the FAR read as follows:

> § 25.812 Emergency lighting.
>
> • • • • •
>
> (e) Floor proximity emergency escape path marking must provide emergency evacuation guidance for passengers when all sources of illumination more than four feet above the cabin aisle floor are totally obscured. In the dark of the night, the floor proximity emergency escape path marking must enable each passenger to --
>
> (1) After leaving the passenger seat, visually identify the emergency escape path along the cabin aisle floor to the first exits or pair of exits forward and aft of the seat; and
>
> (2) Readily identify each exit from the emergency escape path by reference only to markings and visual features not more than four feet above the cabin floor.
>
> • • • • •

6. DEMONSTRATING COMPLIANCE WITH THE RULE. While the rule does not preclude a single system or installation meeting both requirements (§§ 25.812(e)(1) & (2)), the requirements should be evaluated separately in finding compliance with the rule and are discussed separately below.

a. Section 25.812(e)(1).

(1) Section 25.812(e)(1) requires that the marking enable each passenger to visually identify the emergency escape path along the cabin aisle floor; it does not require visual guidance to enable a passenger to move from the seat to the aisle. While the standard does not preclude compliance by the use of conspicuous lighting or marking near the ends of the aisle or at other critical points along the aisle, it does specifically require that the passenger be able to visually identify the emergency escape path itself along the cabin aisle floor. Different approaches to meeting this requirement could be used including, for example, systems which illuminate the floor and seat areas along the escape path, or systems which visually identify the escape path through point sources of light. No specific number, spacing, or location of light sources is required; and acceptable designs may vary depending on factors such as aisle length or interior configuration, as long as the required visual identification of the emergency escape path along the cabin aisle floor is provided. This requirement would not be met by a system which merely provides a distant light at the exit or outlines the escape path, where the escape path remains essentially dark. The fact that a light located in the vicinity of an exit may be partially visible from the point where a passenger enters the aisle after leaving the seat would not constitute compliance with the requirement that the passenger be able to "visually identify the emergency escape path along the cabin aisle floor." Outlining the escape path, but not providing for visual recognition of the cabin aisle floor along the escape path, is also not in compliance with the requirement; i.e., the use of mini or micro bulbs which can be seen when illuminated, but which do not illuminate the surrounding areas, is not acceptable.

(2) While the rule does not require that the escape path marking indicate a particular direction, forward versus aft, in which the passenger should move in an emergency, the system should not tend to lead a passenger toward an end of the cabin where there are no exits. This will be a concern in a limited number of cabin configurations. In most configurations, there are emergency exits (including some classified as "excess" exits) both forward and aft of most passenger seats, and the direction which the passenger chooses to move in an actual emergency will depend on conditions in the cabin, such as crowding, existence of fire or smoke, or usability of different exits.

(3) The escape path markings, coupled with the exit markings discussed below, should be designed so that they will not tend to lead passengers past available exits. This is especially critical in the case of non-floor level overwing exits where continuous seat spacing in most cases obscures the recognition of exit features and markings. Test subject demonstrations have shown that some recognizable aisle cue,

identifiable as the exit location is approached, is necessary to assure passengers do not continue past this type of exit. Also, on multi-aisle airplanes, the required emergency escape path along the cross-aisle floor requires the same level of visual identification as the emergency escape path along the main cabin aisle floor. Test subject demonstrations confirm that required cross-aisle escape paths which cannot be visually identified by passengers act as negative cues. Even passengers who recognize that their next available exit would be across the airplane do not elect to go to that exit because of the inability to visually identify the cross-aisle escape path.

b. Section 25.812(e)(2) requires that the floor proximity emergency marking enable each passenger to readily identify each exit from the emergency escape path by reference only to markings and visual features not more than 4 feet above the cabin floor. The requirement to "readily identify" would be met by a system which enables a passenger to make positive visual identification of the exit itself, without hesitation or delay. It is not sufficient for a passenger to recognize that he or she is in the vicinity of an exit, as by increased general illumination, nor is it sufficient for a passenger to be able to identify only the fore and aft location of the exit along the cabin floor. The exit itself must be sufficiently identifiable to enable a passenger to proceed immediately to it, whether it is in the open or closed position.

c. Critical Ambient Conditions. Sections 25.812(l) and 121.310(d)(3) of the FAR require that the energy supply to each emergency lighting unit provide the required level of illumination for at least 10 minutes at the critical ambient conditions after emergency landing. For compliance with these sections, the appropriate test conditions of Radio Technical Commission for Aeronautics Document No. DO-160B, Section 4, may be used to determine the output level for any emergency power supplies which are used as part of the floor proximity emergency escape path marking. An alternate method of compliance would be to use any combination of analysis, lab tests, or actual airplane tests to show that the energy supply to each emergency lighting unit provides the required level of illumination for at least 10 minutes. The following conditions have been found to be an acceptable alternative:

(1) Cruise Cold Soak.

(i) Airplane flight at the maximum altitude for maximum cruise time.

(ii) Emergency descent and immediate landing at a -40°F ambient temperature.

(iii) Floor proximity emergency escape path marking systems and subsystems activated.

(2) Overnight Cold Soak.

(i) Unconditioned airplane sitting for 8 hours in a ramp environment of -40°F.

(ii) Airplane interior warmed for 2 hours, using normal airplane or ground facilities.

(iii) Immediate aborted takeoff at a -40°F ambient temperature.

(iv) Floor proximity emergency escape path marking systems and subsystems activated.

(3) Hot Day.

(i) Unconditioned airplane sitting for 8 hours in a ramp environment of +120°F.

(ii) Airplane interior cooled for 2 hours, using normal airplane or ground facilities.

(iii) Immediate aborted takeoff at +90°F ambient temperature.

(iv) Floor proximity emergency escape path marking systems and subsystems activated.

d. Transverse Vertical Separation.

(1) Section 25.812(l)(1) of the FAR requires that a single, transverse vertical separation of the fuselage during crash landing must not render inoperative more than 25 percent of all electrically illuminated emergency lights required by § 25.812. The acceptable loss is in addition to the lights that are directly damaged by the separation. The floor proximity emergency escape path marking system, as a part of the airplane emergency lighting system, must comply with this requirement when installed in airplanes whose certification basis includes Amendment 25-15 or later. Compliance with this requirement can be demonstrated by including the floor proximity escape path marking system as part of the total airplane electrically illuminated emergency lights, or by showing that the floor proximity emergency escape path marking system standing alone will comply.

(2) Floor proximity emergency escape path marking system designs have been presented for approval which meet the vertical separation requirement due to the fact that the system, as installed, is divided into segments, each with its own power supply. In such systems, physical separation and redundancy are utilized to assure that no more than 25 percent of the required lights are rendered inoperative.

(3) Other systems are being designed such that light sources are powered in parallel by two power supplies (located fore and aft) so that either power supply will provide the required level of lighting. For such systems, the question of protection against direct shorts (conductor to fuselage or conductor to conductor) becomes relevant in determining the number of inoperative emergency lights resulting from a vertical separation of the fuselage.

(4) Conductor to fuselage direct shorts are considered likely during any fuselage vertical separation and should be accounted for in the system design for compliance with § 25.812(l)(1) during such an event. Conductor to conductor direct shorts, however, need to be evaluated on a system-by-system basis to determine if the intent of the rule is met in that loss of more than 25 percent of the required emergency lights is unlikely. Examples of means which can be utilized to meet the intent of the requirement are design features which result in conductors which act as fuses at the location of short circuits in preventing total loss of system power, or utilization of blocking diodes to assure retention of power supplies. Assumptions involving severing of conductors cleanly and in an open state are not alone satisfactory. The system design must be demonstrated to possess characteristics (i.e., architecture, circuit protection, redundancy, independence, physical separation, design failure modes) which will show that loss of more than 25 percent of the required emergency lights is not likely should a vertical separation occur, resulting in a conducting material severing the fuselage and remaining in proximity to the severed conductors.

e. Dispatch With Inoperative Lights. If eventual approval is desired for dispatch of the airplane with inoperative light units under Minimum Equipment List (MEL) provisions, evaluation of the floor proximity emergency escape path marking system for compliance with the required lighting levels, with the proposed light units inoperative, should be accomplished during the initial system approval to expedite approval under the MEL.

f. Anticipated Wear and Abuse. The design of the system should take into account wear of and abuse to the system typical of the location of the system. Items such as spilled fluids, airline cleaning fluids, and damage from high heels and service carts should be considered.

7. CONDUCT OF EVALUATIONS.

a. Evaluations should be conducted under conditions of darkness. If they are conducted during daylight hours, each window, door, emergency exit (open and closed), and other openings should have provisions to prevent light from entering the passenger cabin. Each internal door and curtain should be in the takeoff configuration. During the evaluation, only the floor proximity escape path marking system being evaluated should provide light. The output of the floor proximity emergency escape path marking system power supplies should be that which would exist after 10 minutes of continuous operation under the "critical ambient conditions" determined under

paragraph 6c. Also, if approval is requested with inoperative light units as noted in paragraph 6e, the system should be configured with the desired light units inoperative.

b. These evaluations are intended to verify the efficacy of floor proximity markings when all lighting more than 4 feet above the cabin aisle floor is totally obscured by dense smoke. In an actual fire, illumination from the floor proximity system would be confined to the area beneath the overlaying smoke and would not illuminate or reflect throughout the cabin in general. In a demonstration in which there is no overlaying smoke, illumination from the floor proximity system might reflect into the upper cabin and produce unrealistic illumination for the cabin and escape path. Unrealistic reflections and illumination should be accounted for in demonstrations, either through a rational determination that they do not change the validity of the demonstration results, or through the use of shielding or shrouding, if necessary, to minimize or eliminate their effects.

c. While in an actual fire the obscuring layer of smoke might vary along the length of the cabin above and below 4 feet, this figure is used as a nominal design height for purposes of the rule, and the air below this is deemed clear for purposes of floor proximity marking design.

d. The evaluation should account for passengers who are either alone or in nearly vacated sections of the cabin, who must find their way to the exit without benefit of crewmembers, queues of passengers, human voices, or other cues to aid them.

e. Since the evaluation is to determine the effectiveness of a system which is to provide visual reference and orientation, and is not a test of egress performance and evacuation rate, the distribution of articles to create minor obstructions in the aisle, as is done for full-scale evacuation demonstrations, is not essential. However, if the design of the floor proximity marking system is such that its performance may be compromised by the presence of a limited amount of carry-on baggage, blankets, pillows, and other similar articles in the aisles or in the vicinity of the emergency exits, then the evaluation should account for this situation. The same holds true for carry-on baggage stowed under seats. The evaluation should be done with baggage under the seats representative of what would be there in a fully occupied airplane. While this may not be necessary for all systems, it would be particularly critical in a system where illumination is provided from light sources which project under the seats.

f. Evaluations should also account for conditions which can be reasonably anticipated to occur in emergency evacuations which might compromise the effectiveness of the floor proximity escape path marking system. For example, passengers bunching at the exits or flight attendants assisting in the evacuation may tend to block light sources near the exits. This may be critical for systems relying on a minimum number of light sources, particularly when those sources are located where they are likely to be blocked during an emergency evacuation.

g. While the rule does not require a demonstration of the system using test subjects representative of airline passengers, this may prove useful in some cases for identifying strengths or weaknesses of particular systems, which may not be apparent to engineering personnel familiar with the system and the aircraft layout. The following guidance should be used in demonstrations with test subjects and should also be considered during engineering evaluations done without test subjects. The test subject acting alone and without assistance should be able to:

(1) Leave the passenger seat or seat row and enter the walkway area immediately adjacent (visual reference to the escape path marking need not be used to assist the test subject in locating the walkway area immediately adjacent to the seat or seat row);

(2) Standing or stooping in the adjacent walkway area, identify from visual reference to the floor proximity marking system the direction(s) of the first exit or pair of exits forward and aft and indicate to the observer the means by which identification is made;

(3) Traverse to those exits without significant hesitation, delay, or evidence of confusion; and

(4) Make positive identification of the exits by visual reference to features not more than 4 feet above the cabin floor and indicate to the observer the means by which identification is made. The exits may be open or closed for the demonstration. Identification should be made for at least one exit of each type and marking system in the cabin, in both the open and closed positions.

h. The test subjects used in the demonstrations noted in paragraph 7g should not be crewmembers, mechanics, or training personnel who maintain or operate the airplane in the normal course of their duties. They should be representative of the average airline passenger with regard to male/female population and age categories. A minimum of three test subjects should be used to evaluate each exit identifier/aisle marking configuration provided. Subjects should be admitted to the cabin one at a time, and given the preflight briefing under normal cabin lighting conditions. After the preflight briefing on exit locations, and while the individual providing the briefing is explaining the role of the test subject, all exit markings above 48 inches affecting the exits to be evaluated should be covered. On twin-aisle airplanes, once a companion exit has been identified, the test subject can be told that exit is unuseable and asked to

locate the next available exit to evaluate the cross-aisle escape path marking. The test subjects that have completed the test should be kept segregated from the other test subjects.

LEROY A. KEITH
Manager, Transport Airplane Directorate
Aircraft Certification Service, ANM-100

APPENDIX 1. ACCEPTABLE MARKING SYSTEMS

The following types of systems have been found acceptable for different areas of the floor proximity emergency escape path marking.

1. Escape Path Marking Along the Cabin Aisle Floor.

   a. Electro-luminescent lighting strips along the floor.

   b. Incandescent light tracks or assemblies along the floor.

   c. Seat mounted incandescent light assemblies.

   d. Seat mounted electro-luminescent lighting strips.

   e. Multiple incandescent, remotely activated flood lights.

2. Escape Path Marking Along the Escape Path Cross-Aisle Floor.

   a. Incandescent light tracks or assemblies along the floor or on forward or aft face of cross-aisle structural bulkheads.

   b. Electro-luminescent lighting strips along floor or on forward or aft face of cross-aisle structural bulkheads.

   c. Remotely activated incandescent floodlights.

   d. Incandescent floodlight located at door jamb.

3. Aisle Cues for Non-Floor Level Overwing Exits.

   a. Multiple red lenses closely spaced in a segment of light track along the floor.

   b. Red lens light assemblies on the floor.

   c. Subdued strobe light at exit sidewall.

   d. Orange overlayed electro-luminescent light strip.

   e. Exit identifier mounted on adjacent seat end bay.

4. Exit Markers.

a. Light-emiting diode (LED) exit identifier with "EXIT" legend, adjacent to exit.

b. Incandescent or electro-luminescent exit identifier with "EXIT" legend adjacent to exit.

c. Incandescent light assembly with "EXIT" legend located on exit access floor adjacent to exit.

d. Incandescent or electro-luminescent light assemblies adjacent to exits with recognizable exit features.

5. Directional Markers for Cabin Zones with Exits at Only One End.

a. Directional arrow overlays on incandescent light tracks/assemblies or electro-luminescent light strips.

b. Illuminated directional placards on aisle seat end bays and vertical bulkheads.

APPENDIX C: CAA AIRWORTHINESS NOTICE N° 56

1. Description
   The integral text of CAA Airworthiness Notice n° 56 is listed for reference on an informational basis.

2. CAA Airworthiness Notice n° 56, Issue 4, 17 March 1992

CIVIL AVIATION AUTHORITY

AIRWORTHINESS NOTICE

No. 56
Issue 4
17 March 1992

THIS NOTICE GIVES DETAILS OF A MANDATORY ACTION

EMERGENCY FLOOR PATH LIGHTING SYSTEM

1 This Notice provides additional information on the installation of an Emergency Floor Path Lighting System required by the Air Navigation Order Schedule 4, scale Z(iii).

2 Interpretation of Requirements

2.1 The following guidance information is provided with the objective of ensuring a consistent and uniform interpretation of the emergency floor path lighting system requirements.

2.2 The markings and illumination provided should enable the passenger to visually identify the escape path along the cabin aisle floor.

NOTE: It is not necessary to provide visual guidance to enable passengers to move from their seat to the cabin aisle.

2.3 The illumination should be of sufficient intensity to enable the passenger to identify features bounding the cabin aisle.

2.4 here exits are to be found in one direction only, the system should not tend to lead the passenger toward the end of the cabin where there are no exits.

2.5 The escape path markings, coupled with exit markings, should be so arranged that a passenger will not tend to proceed along the cabin aisle past any available exits. It is recommended that conspicuous markers be placed at the point of access from the cabin aisle to the exit.

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2.6 **Exit Identification**

2.6.1 Only those exits which are either 'designated' emergency exits or 'excess' emergency exits should be identified by the emergency floor path lighting system.

NOTE: 'Designated' emergency exits are the minimum required for the certificated passenger capacity. 'Excess' emergency exits are additional exits to the minimum required which satisfy the same arrangement, marking and lighting requirements as for 'designated' exits and which are also readily accessible.

2.6.2 The exit should be positively identifiable to enable a passenger to proceed to it without hesitation in conditions where the exit is either open or closed. All exits likely to be available for use in an emergency should, therefore, have exit identifiers.

2.6.3 Exit identifiers of floor level exits need to be located so that they can be seen directly when adjacent to the last aisle marker, or in the case of a flood-lit system, within the flood-lit zone, and viewed on the vertical centre line of the aisle at a height no more than 4 feet above the cabin floor level. Additional cues to a passenger may, however, be provided as an alternative such as horizontally mounted exit identifiers located on an aft or forward bulkhead in the vestibule leading to an exit and within direct line of sight of a passenger when approaching the vestibules from the aisle.

2.6.4 Exit identifiers should, wherever practicable, be located at such a distance from the floor that they will not be obscured by any strewn hand baggage likely to be present in an emergency evacuation. It is, therefore, recommended that exit identifiers be located between 18 inches and 4 feet above the cabin floor level.

2.6.5 Where exit identifiers are mounted on cabin sidewalls and located close to passenger seats, they should be visible from the aisle with the seat next to the identifier occupied. This takes account of a passenger seated next to an exit being incapacitated. (A passenger slumped forward or sideways should also be considered.)

2.7 **Escape Path Markings along Cabin Aisle Floor**

2.7.1 Where single point incandescent type or electroluminescent strip type floor track markers are employed, the CAA recommends a distance between markers no greater than 20 inches (thus permitting a maximum distance between markers of 40 inches

under typical Minimum Equipment List (MEL) conditions).

NOTE: Where incandescent lights are installed on the side of seats the distance between lights should not exceed 40 inches.

2.7.2 Floor track cabin aisle markers should be clearly visible when viewed from the aisle centre line at a height of 4 feet above the cabin floor.

2.7.3 At each end of a passenger cabin it is recommended that there are red/orange floor track cabin aisle markers (either, at least two closely spaced incandescent markers or, a short length of electroluminescent strip) to highlight clearly the ends of the aisle.

2.8 **Escape Path 'Flood Lighting' of Cabin Aisle**

2.8.1 Where a 'flood lighting' system is employed the maximum distance between light sources is to be agreed with the CAA and this will be dependant upon the intensity and distribution of light available.

2.9 **Aisle Cues for Overwing Exits**

2.9.1 Floor track marking system aisle cues for overwing exits are recommended to comprise three, with a minimum of two, closely spaced red/orange markers or a suitable length of red/orange strip-lighting, adjacent to the access route to overwing exits.

2.9.2 Where access to an overwing exit is achieved by a dual access route, the aisle cues should be located at the entrance to both access routes or be located so as not to bias one route when compared with the other.

2.9.3 Escape Path 'flood lighting' systems do not normally provide adequate aisle cues for overwing exits and should be complemented by the provision of some discrete cues so located that they can be seen by a passenger at a maximum height of 4 feet above the cabin floor when moving down the aisle (strobe lights are not considered to be effective cues, especially when smoke is present).

2.10 **Cross Aisle Escape Path Markings**

A similar level of floor proximity escape path marking/illumination should be provided in cross aisles on multi-aisle aircraft to that provided for the cabin main aisles.

2.11 **The 25 Percent Rule**

2.11.1 Each escape path marking system is required to meet existing FAR/JAR 25.812 requirements. In particular, FAR/JAR 25.812(l)(1) requires that not more than 25 percent of the escape path marking system lights are rendered inoperative after any single transverse vertical separation.

2.11.2 For systems in which the lights are controlled by remote transmitters there must be sufficient transmitters installed to ensure that the FAR/JAR 25.812(l)(1) requirement can be met even though, in a crash, there may be a considerable distance between the two vertically separated parts of the fuselage.

3 Evaluations

3.1 The means provided in showing compliance with the requirement of the ANO shall be the subject of an evaluation by the CAA. In addition, all concepts not already approved shall be the subject of a demonstration to determine both the strengths and weaknesses of a particular system.

3.2 Engineering evaluations and demonstration tests should be conducted in conditions of darkness either at night or where conditions have been simulated by preventing daylight from entering through windows or through exits whether open or closed.

3.3 Where it is intended that an aircraft's MEL is to permit continued operation of the aircraft with some elements of the system unserviceable, the test subject demonstration should be conducted with the system configured so as to simulate the relevant MEL standard.

3.4 A demonstration should clearly show, to the satisfaction of the CAA, that test subjects, on leaving their seat in any part of the passenger compartment and entering the cabin aisle, can, using the visible signs and markings, immediately determine in which direction(s) exits are to be found using visual references only.

3.5 The demonstration is intended to establish that there are adequate visual references which will provide the necessary orientation of the passengers. It is not necessary to assess the passenger evacuation rate under these conditions. Obstructions created by loose cabin baggage, etc., need not, therefore, be simulated, except in so far as baggage might interfere with an illumination system.

3.6 In assessing the effectiveness of all visual cues, the existing emergency lighting system which provides illumination from locations more than 4 feet above the cabin aisle floor, must be switched off. It is not intended that the test should be performed in conditions of smoke but simply taking into account its blanketing effect. Therefore, care needs to be taken to ensure that, in the absence of an overlaying smoke, the floor proximity system is prevented from illuminating and hence reflecting light from parts of the cabin above the 4 foot level.

3.7 Test subjects should not have detailed knowledge of the aircraft other than that obtainable from a study of the normal Passenger Safety Leaflet. The total number of test subjects is not critical but they should be adults and should include both males and females over 60 years of age.

3.8 The precise details of any demonstration should be discussed and agreed with the CAA but should include consideration of the following:–

In each demonstration, the test subject acting alone and without any assistance should be able:–

(a) to leave the seat or seat row and enter the cabin aisle;

(b) standing or stooping in the aisle and making use of the visual reference to the floor proximity marking system, to identify and locate the first exit or pair of exits either forward or aft (where appropriate);

(c) to proceed to the particular exit(s), without significant hesitation or evidence of confusion, making all exit identifications by reference only to visible features not more than 4 feet above the cabin floor.

After each test, the test subject should indicate to the observers the means by which the exit was located.

3.9 A sufficient number of tests should be performed to ensure that, at least, one exit of each type in the passenger cabin has been identified with the exit both open and closed using the associated marking systems. (Safety precautions should be taken particularly for any demonstration involving open exits).

4 Cancellation This Notice cancels Airworthiness Notice No. 56, Issue 3, dated 25 October 1991, which should be destroyed.

for the Civil Aviation Authority

Safety Regulation Group
Aviation House
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West Sussex RH6 0YR

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